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INVENTION: CONTROLLER FOR PHOTOGRAPHING APPARATUS AND
PHOTOGRAPHING SYSTEM

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CERTIFIED TRANSLATION

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- (1) that she knows well both the Japanese and English languages;
- (2) that she translated Japanese Application No. H09-261827
from Japanese to English;
- (3) that the attached English translation is a true
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Date

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[Title of Document] Specification

[Title of the Invention] Controller for Photographing
Apparatus and Photographing System

[Scope of Claims for a Patent]

5 [Claim 1]

A controller for a photographing apparatus for
controlling the photographing direction of photographing
means that is connected through a transmission path,
comprising:

10 driving means for controlling the photographing
direction of said photographing means;

picture selecting means for controlling said
driving means and selecting a picture displayed by said
photographing means;

15 a picture displaying area for driving said
photographing means by said driving means and corresponding
to the displayable range; and

means for superimposing a panorama picture on said
picture displaying area.

20 [Claim 2]

A controller for a photographing apparatus for
controlling the photographing direction of photographing
means connected through a transmission path, comprising:

25 driving means for controlling the photographing
direction of said photographing means; and

a picture selecting means for controlling said
driving means and selecting a picture displayed by said

photographing means,

wherein said picture selecting means comprises an operation area for driving said photographing means by said driving means and corresponding to the displayable range,

5 wherein a panorama picture of said displayable range area superimposed and the user designates a desired point so as to move an object at the position corresponding to said desired point to a desired positional coordinates of said driving means in said operation area.

10 [Claim 3]

A controller for a photographing apparatus for controlling the photographing direction of photographing means that is connected through a transmission path, comprising:

15 driving means for controlling the photographing direction of said photographing means; and

picture selecting means for controlling said driving means and selecting a picture displayed by said photographing means,

20 wherein said picture selecting means comprises an operation area for driving said photographing means by said driving means and corresponding to the displayable range,

wherein a panorama picture in said displayable range is superimposed and the user designates a desired area so as to move an object at the position corresponding to a desired point generated from said desired area to the desired positional coordinates of said driving means in said operation

25

area.

[Claim 4]

A controller for a photographing apparatus as set forth in claim 1,

5 wherein a current position of said driving means is displayed on a panorama picture in said picture displaying area.

[Claim 5]

10 A controller for a photographing apparatus as set forth in claim 2 or 3,

 wherein a current position of said driving means is displayed on a panorama picture of said picture selecting means.

[Claim 6]

15 A controller for a photographing apparatus as set forth in claim 1,

 wherein the moving range of said driving means is displayed on a panorama picture of said picture displaying area.

20 [Claim 7]

 A controller for a photographing apparatus as set forth in claim 2 or 3,

 wherein the moving range of said driving means is displayed on a panorama picture of said picture selecting means.

25

[Claim 8]

A controller for a photographing apparatus as set

forth in claim 1,

wherein the angle of view of said photographing means is displayed on a panorama picture of said picture displaying area.

5 [Claim 9]

A controller for a photographing apparatus as set forth in claim 2 or 3,

wherein the angle of view of said photographing means is displayed on a panorama picture of said picture selecting means.

10 [Claim 10]

A controller for a photographing apparatus as set forth in claim 1, 2, or 3,

wherein an operation area to which a current picture displayed by said photographing means is put is included, and

wherein the user designates a desired point so as to move an object at the position corresponding to a desired point to a desired positional coordinates of said driving means in said operation area.

20 [Claim 11]

A controller for a photographing apparatus as set forth in claim 1, 2, or 3,

wherein said picture selecting means comprises an operation area to which a current picture displayed by said photographing means is put, and

wherein the user designates a desired area so as

to move an object at a position corresponding to a desired position generated from said desired area to a desired positional coordinates of said driving means in said operation area.

5 [Claim 12]

A photographing system for connecting photographing means and a controller for a photographing apparatus through a transmission path and controlling driving means for controlling the photographing direction of said photographing means by said controller for a photographing apparatus,

wherein said controller for a photographing apparatus comprises:

15 a picture selecting means for controlling said driving means and selecting a picture displayed by said photographing means;

a picture displaying area for driving said photographing means by said driving means and corresponding to the displayable range; and

20 means for superimposing a panorama picture on said picture displaying area.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention belongs]

25 The present invention relates to a controller for a photographing apparatus and a photographing system with a high operational characteristic and a high visibility

suitable for a photographing operation, using lines, of the apparatus that is disposed at a remote place and that is used for a monitoring operation, an observing operation, a guiding operation, a presenting operation, and so forth.

5 [0002]

[Prior Art]

As shown in Fig. 21, when the user controls a photographing apparatus disposed at a remote place, he or she operates a pan tilter in eight directions (up, down, left, right, upper right, lower right, upper left, and lower left directions) with eight-direction keys, a zooming controller, and a wide-angle controller so as to photograph a desired object while observing a photographed picture on a monitor 2. Alternatively, after the user has controlled a photographing apparatus disposed at a remote place in the above-described method and registered pan tilter information and zoom information of positions of pictures to be photographed, he or she drives the photographing apparatus at absolute positions corresponding to the registered positions so as to select pictures.

20 [0003]

[Subject that the Invention is to solve]

However, when picture and control information is exchanged with a photographing apparatus disposed at a remote place through a low-capacity network, the control information may be lost and/or picture information may be delayed due to an irregularity of their arrival intervals. If the pan

tilter or the zooming controller is operated in conventional method for picture and control information that has been delayed or lost, even if the user causes the pan tilter and the zooming controller to place the object at the desired position, the pan tilter and the zooming controller do not properly operate. Thus, the object is placed at an improper position due to the delay or line condition. Thus, the user should control the pan tilter and the zooming controller based on a prediction. Consequently, the user cannot properly control the pan tilter and the zooming controller.

[0004]

At this time, a pan tilter and a zooming controller are controlled through a feed-back operation and an experience. Therefore, when a picture loses its real time, the amount of the feed-back becomes unstable.

[0005]

In addition, since the current picture is only a part that the photographing apparatus can move with the pan tilter, when the user detects the desired object from the moving range, all the moving range of the pan tilter is driven. In order to solve these subjects, it was desirable the controlling result is predicted beforehand and the condition of the photographing apparatus can be easily known.

[0006]

Therefore, an object of the present invention is to provide a picture selecting means, a controller for a photographing apparatus and a photographing system for allowing

the user to easily obtain the desired picture with a photographing apparatus that is operated according to the picture selecting means.

[0007]

5 Furthermore, an object of the present invention is to provide a controller for a photographing apparatus and photographing system for allowing the user to designate a desired position or a desired area on a panorama picture displayed as a part or all the moving range of a pan tilter
10 so that the user can easily obtain a desired picture with the photographing apparatus.

[0008]

[Means for solving the subject]

15 The present invention described in claim 1 is a controller for a photographing apparatus for controlling the photographing direction of photographing means that is connected through a transmission path, comprising: driving means for controlling the photographing direction of said photographing means; picture selecting means for controlling
20 said driving means and selecting a picture displayed by said photographing means; a picture displaying area for driving said photographing means by said driving means and corresponding to the displayable range; and means for superimposing a panorama picture on said picture displaying
25 area.

[0009]

The present invention described in claim 12 is

a photographing system for connecting photographing means
and a controller for a photographing apparatus through a
transmission path and controlling driving means for
controlling the photographing direction of said photographing
5 means by said controller for a photographing apparatus, wherein
said controller for a photographing apparatus comprises:
a picture selecting means for controlling said driving means
and selecting a picture displayed by said photographing means;
a picture displaying area for driving said photographing
10 means by said driving means and corresponding to the displayable
range; and means for superimposing a panorama picture on
said picture displaying area.

[0010]

A picture photographed by a pan tilter camera that
15 is disposed at a remote place and that can be moved in various
directions through a circuit is sent to a computer. The
picture is displayed as a panorama picture in a display area
of a monitor. The direction of a picture selecting means
corresponding to the direction of an object to be placed
20 at the center of the angle of view of the photographing apparatus
in the panorama picture is designated by a pointing device
connected to the computer. Since the pan tilter is controlled
with reference to the panorama picture, a desired picture
can be photographed by the photographing apparatus.

25 [0011]

The present invention described in claim 2 is a
controller for a photographing apparatus for controlling

the photographing direction of photographing means connected through a transmission path, comprising: driving means for controlling the photographing direction of said photographing means; and a picture selecting means for controlling said driving means and selecting a picture displayed by said photographing means, wherein said picture selecting means comprises an operation area for driving said photographing means by said driving means and corresponding to the displayable range, wherein a panorama picture of said displayable range area superimposed and the user designates a desired point so as to move an object at the position corresponding to said desired point to a desired positional coordinates of said driving means in said operation area.

[0012]

The present invention described in claim 3 is a controller for a photographing apparatus for controlling the photographing direction of photographing means that is connected through a transmission path, comprising: driving means for controlling the photographing direction of said photographing means; and picture selecting means for controlling said driving means and selecting a picture displayed by said photographing means, wherein said picture selecting means comprises an operation area for driving said photographing means by said driving means and corresponding to the displayable range, wherein a panorama picture in said displayable range is superimposed and the user designates a desired area so as to move an object at the position

corresponding to a desired point generated from said desired area to the desired positional coordinates of said driving means in said operation area.

[0013]

5 A picture photographed by a pan tilter camera that is disposed at a remote place and that can be moved in various derrections through a circuit is sent to a computer. The picture is displayed in a display area of a monitor. In the case that a pan tilter camera has been set up the picture
10 is displayed as a panorama picture in a panorama operation area. A desired point to be placed at the center of the angle of view of the photographing apparatus in a picture of the operation area or the panorama operation area or a desired point generated with a desired area is designated
15 by the pointing device connected to the computer. Thus, in the method of which the result is input, a selected object can be easily placed at the center of the screen. In addition, since a desired point in the operation area on the screen or a desired point generated with a desired area is designated
20 with the pointing device, the user can easily know the driving direction of the pan tilter camera.

[0014]

[Embodiment of the Invention]

25 Next, with reference to the accompanying drawings, embodiments of the present invention will be described. Fig. 1 shows an external view. A monitor 2 and a mouse 8 are connected to a computer 1. The computer 1 controls the driving

operation of a pan tiler camera 3 disposed at a remote place through a server 9 and a transmission path. In other words, a controller for the photographing apparatus is composed of the computer 1. As a transmission path, a communication line(wirelesscommunicationline,wiredcommunicationline), network and the like are usable. Since the computer 1 and the server 9 are in the client relation, a plurality of the computer 1s can be connected to the server 9.

[0015]

The pan tiler camera 3 is integrally composed of a pan tiler portion and a camera portion. In Fig. 1, the pan tiler camera 3 and the server 9 are disposed on a real scene as denoted by 4. A screen of a picture photographed by the pan tiler camera 3 is denoted by 5. This screen is hereinafter referred to as a photographed screen. The photographed screen 5 is an actually photographed screen. When a zoom lens of the pan tiler camera 3 is placed on the telephotograph side, the angle of view decreases. In contrast, when the zoom lens of the pan tiler camera 3 is placed on the wide-angle side, the angle of view increases.

[0016]

A picture on a photographed screen 5 captured by a pan tiler camera 3 is sent to a computer 1 through the server 9 and a transmission path. The picture sent to the computer 1 is displayed on a monitor 2. The monitor 2 displays the photographed screen 5 in an operation area 6A on the monitor 2. A panorama picture including the picture

photographed by the pan tilter camera 3 is displayed in a
panorama operation area 6B. In this example, an arrow-shaped
cursor 7 is displayed at the position of a mouse pointer
of a mouse 8 in the panorama display area 6B, and a frame
5 6C of which the mouse 8 is the center is displayed. A picture
surrounded by the frame 6 of the panorama operation area
6B are displayed in the operation area 6A. As described
later, the panorama operation area 6B comprises a pan tilter
limiter 6D, and the pan tilter limiter 6D represents the
10 limit of the moving range of the pan tilter camera 3.

[0017]

That is, as shown in Fig. 2, the operation area
6A and the panorama operation area 6B area displayed on the
monitor 2. Though not shown, a picture that is supplied
15 from the pan tilter camera 3 disposed at a remote place through
the server 19 and the transmission path is displayed in the
operation area 6A, and panorama pictures is displayed in
the panorama operation area 6B. The panorama pictures are
supplied from the pan tilter camera 3, and then combined.

20 [0018]

Fig. 3 is a block diagram showing the overall system
according to the embodiment of the present invention. The
system shown in Fig. 3 comprises a camera portion 11, a pan
tilter portion 12, a TV monitor 13, a server 9, a computer
25 1, a pointing device 14 (such as a mouse 8), and a monitor
2. The pan tilter camera 3 comprises a camera portion 11
and a pan tilter portion 12. For example, the camera portion

11 is disposed on the pan tilter portion 12. The camera portion 11 comprises a lens block portion 15, a zoom lens 16, a zoom portion 17, a zoom lens motor 18, a solid state image pickup device 19, a signal separating/automatic gain adjusting circuit (SH/AGC) 20, an A/D converter 21, and a signal processing circuit 22. The camera portion 11 represents a video camera.

[0019]

The pantilterportion12comprisesamodecontroller 23, a camera controller 24, a pan tilter controller 25, a pan motor 26, a tilt motor 27, and a pan tilter 28. The computer1comprisesacontrollingportion31, avideocapture portion 29, and a storing portion 30. The video capture portion 29 is composed of a video capture board.

[0020]

Rays emitted from an object are focused to the solid state image pickup device 19 through a lens set and a diaphragm of the lens block portion 15. An example of thesolidstateimagepickupdevice19is a CCD (Charge Coupled Device). The focused rays (field picture) are converted into a picture signal and then sent to the signal separating/automaticgainadjustingcircuit20. The signal separating/automaticgainadjustingcircuit20samples/holds thepicture signal and controls the gain of the picture signal with a control signal of an auto iris (AE). The resultant picture signal is sent to the signal processing circuit 22 through the A/D converter 21. The signal processing circuit

22 converts the received picture signal into a brightness signal (Y), a color signal (C), and a video signal and sends these signals as picture signals to the video capture portion 29 of the computer 1 through the TV monitor 13 and the server 9.

[0021]

The lens block portion 15 of the camera portion 11 is a zoom lens that drives the zoom lens 16 and thereby varies the angle of view of an object to be photographed.

The lens block portion 15 causes the zoom lens motor 18 that is for example a stepping motor to rotate, thereby driving the zoom lens 16 corresponding to a drive command received from the camera controller 24 of the pan tilt portion 12.

The camera controller 24 performs a lens controlling operation (for example, focusing operation and zooming operation), an exposure controlling operation (for example, diaphragm controlling operation, gain controlling operation, and speed controlling operation of electronic shutter), white balance controlling operation, a picture quality controlling

operation, and so forth of the camera portion 11. In addition, the camera controller 24 interfaces with the mode controller 23. As interface controlling operations with respect to the zoom lens 16, the camera controller 24 sends a control signal to the motor driver corresponding to a drive command of the zoom lens 16 received from the mode controller 23, so that the zoom lens 16 is placed at the position designated by the command. In addition, the camera controllers 24 always

sends positional information of the zoom lens 16 to the mode controller 23.

[0022]

5 The camera portion 11 is disposed on the pan tilter portion 12 that has a degree of freedom that are rotating directions of two axes of pan and tilt. The pan tilter portion 12 causes the pan motor 26 and the tilt motor 27 to rotate corresponding to a drive command received from the pan tilter controller 25, thereby driving a pan head and a tilt head of the pan tilter 28. The motors 26 and 27 are composed of for example stepping motors. The pan tilter controller 25 sends a control signal to the motor drivers so that the pan head and the tilt head are driven to positions corresponding to a pan drive command and a tilt drive command received from mode controller 23. In addition, the pan tilter controller 25 always sends positional information of the pan head and the tilt head to the mode controller 23.

[0023]

20 The mode controller 23 controls the overall system corresponding to the internal states of the camera portion 11 and the pan tilter portion 12 and the interface information received from the outside of the pan tilter camera 3 as will be described later. The mode controller 23 is connected with for example the computer 1 and RS-232C interface. The mode controller 23 sends drive commands received from the computer 1 to the pan tilter controller 25 and the camera controller 24 so as to drive the pan tilter 28 and the zoom

lens 16 of the lens block portion 15. In addition, the mode controller 23 sends current positional information received from the pan tilter controller 25 and the camera controller 24 to the computer 1.

5 [0024]

According to the embodiment, the computer 1 is used to select a picture photographed by the pan tilter camera 3. The computer 1 processes graphics in the operation area 6A and the panorama operation area 6B displayed on the monitor 2 and information of a designated position and a clicking operation of the pointing device 14 (mouse 8) and sends the resultant data to the mode controller 23. To display a picture photographed by a camera portion 11 on the monitor 2, a video capturing portion 29 is used. The video capturing portion 29 allows a video signal received from the camera portion 11 to be displayed on the monitor 2 with a desired picture quality. In addition, the video capturing portion 29 allows a picture to be captured in a particular picture format (for example, bit map format, still picture JPEG format, moving picture JPEG format, or the like) with a particular picture quality and to be stored in the storing portion 30 (for example, a hard disk) of the computer 1.

[0025]

Next, with reference to Fig. 4, an example of a method for generating a panorama picture will be described. Now, it is assumed that the environment in the place where the pan tilter camera 3 is disposed is a spherical surface.

The spherical surface is referred to as virtual spherical surface. In Fig. 4, two adjacent pictures on the virtual spherical surface are combined to one panorama picture. To generate a panorama picture, as shown in Fig. 4A, the pan
5 tilter camera 3 is disposed at the center of the sphere photographs two adjacent pictures on the virtual spherical surface. The pan tilter camera 3 photographs a plane perpendicular to the optical axis of the lens thereof. Fig. 4D shows a situation of which two adjacent pictures on the virtual spherical surface
10 are photographed by the pan tilter camera 3 and the two pictures are mapped to the plane perpendicular to the optical axis. When two adjacent pictures are simply combined, they overlap and distort at the overlapped portion.

[0026]

15 To prevent two adjacent pictures from overlapping and distorting, they are mapped to the virtual spherical surface as shown in Fig. 4B. Fig. 4E shows a situation of which two photographed pictures that are planes perpendicular to the optical axis are mapped to the virtual spherical surface.
20 In such a manner, planes perpendicular to the optical axis (namely, photographed pictures) are mapped to the virtual spherical surface. The mapped pictures are combined in such a manner that an overlapped portion and an unnecessary portion are removed. The picture mapped on the virtual spherical
25 surface is normalized with longitude and latitude. Thus, a panorama picture as shown in Figs. 4C and 4D is generated.

[0027]

Next, a method for generating a panorama picture will be described. In this method, as shown in Fig. 5, one panoramapictureisgeneratedbycombining10pictures. First, the pan tilter camera 3 (not shown) disposed at the center of the sphere photographs 10 pictures. At this point, as shown in Fig. 5A, by matching the optical axis of the lens of the pan tilter camera 3 to positions denoted by circles, the pan tilter camera 3 can obtain pictures 1 to 10. As shown in Fig. 5B, the pictures photographed by the pan tilter camera 3 are pictures on the plane perpendicular to the optical axis of the lens. The obtained pictures are mapped to the virtual spherical surface. Thereafter, as shown in Fig. 5C, the pictures are normalized with latitude and longitude. The pictures are obtained in such a manner that they are smoothly combined without a break. Thereafter, an overlapped portion and unnecessary portion are removed. Thus, a panorama picture of which 10 pictures are smoothly combined is generated.

[0028]

Next, with reference to Fig. 6, another method for generating a panorama picture will be described. In this method, pixels obtained by the pan tilter camera 3 are designated to pixels of a panorama picture normalized with latitude and longitude (namely, coordinates (s, t)). As in the method shown in Fig. 5, when pixels of pictures photographed by the pan tilter camera 3 are designated to pixels of a panorama picture, part of pixels of the panorama picture may not be designated. All pixels of pictures

photographed by the pan tilter camera 3 should be designated to pixels of the panorama picture. The panorama picture is composed of pixels calculated for individual coordinate points in the following process. Angular coordinates (α , β) (see Fig. 6B) on the virtual spherical surface corresponding to coordinates (s , t) (see Fig. 6) of a panorama picture are calculated corresponding to Eq. (1).

[0029]

$$(\alpha, \beta) = (a(s), b(t)) \quad \dots (1)$$

(Eq. (1) will be described later with reference to Fig. 7.)

[0030]

As shown in Fig. 6C, coordinate data (ξ, η) of the obtained picture is calculated with the coordinates (s, t), the angular coordinates (θ, ϕ) of a pan tilter 28, and photographing magnification assuming that the wide edge of the photographing apparatus is defined as one magnification corresponding to Eq. (2).

[0031]

$$(\xi, \eta) = (f(\alpha, \beta, \theta, \phi, \gamma), g(\alpha, \beta, \theta, \phi, \gamma))$$

$\dots (2)$

(Eq. (2) will be described later with reference to Fig. 8.)

[0032]

Corresponding to the above-described equations, pixels of the panorama picture are correlated with obtained pictures so as to generate a combined picture (namely, the panorama picture).

[0033]

Next, with reference to Fig. 7, a method for converting coordinates (s, t) of a panorama picture into angular coordinates (α , β) on the virtual spherical surface will be described. In Fig. 7A, PragMin represents angular data at the left edge assuming that the home position of the pan tilter 28 is 0 (rag). PragMax represents angular data at the right edge assuming that the home position of the pan tilter 28 is 0 (reg). Ny_2 represents a horizontal coordinate of the panorama operation area 6B. $-Ny_2 / 2$ represents coordinate data at the right edge of the panorama operation area 6B.

[0034]

To obtain the pan angle α with the coordinate data s, since the following relation is satisfied

$$(PragMax - \alpha) : (PragMax - PragMin) = (Ny_2 / 2 - s) : Ny_2$$

the pan angle α is expressed as follows.

$$\alpha = PragMax - (PragMax - PragMin) \times (Ny_2 / 2 - s) / Ny_2$$

[0035]

In Fig. 7B, TragMin represents angular data at the upper edge assuming that the home position of the pan tilter 28 is 0 (rag). TragMax represents angular data at the lower edge assuming that the home position of the pan tilter 28 is 0 (rag). Nz_2 represents a vertical coordinate of the panorama operation area 6B. $-Nz_2 / 2$ represents coordinate data at the upper edge of the panorama operation

area 6B. $Nz_2 / 2$ represents coordinate data at the lower edge of the panorama operation area 6B.

[0036]

To obtain the tilt angle β with the coordinate data t , since the following relation is satisfied,

$$(\text{TragMax} - \beta) : (\text{TragMax} - \text{TragMin}) = (Nz_2 / 2 - t) : Nz_2$$

the tilt angle β is expressed as follows.

$$\beta = \text{TragMax} - (\text{TragMax} - \text{TragMin}) \times (Nz_2 / 2 - t) / Nz_2$$

[0037]

Next, with reference to Fig. 8, the method for converting a plane into a spherical surface will be described. As shown in Fig. 8A, the spatial coordinates of a point (ξ, η) of a photographed picture orienting the home position (the origin of latitude and longitude) are expressed as follows.

[0038]

[Equation 1]

$$\begin{aligned} P &= e_x + k_1 \xi e_\xi + k_2 \eta e_\eta \\ &= \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} + k_1 \xi \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} + k_2 \eta \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \\ &= \begin{bmatrix} 1 \\ -k_1 \xi \\ k_2 \eta \end{bmatrix} \end{aligned}$$

20

[0039]

At this point, the following relations are satisfied.

$$k_1 = \tan (\lambda / 2\gamma) / (N_y / 2)$$

$$k_2 = \tan (\mu / 2\gamma) / (N_z / 2)$$

5 where (N_y, N_z) represent the drive ranges (y direction and z direction) of the mouse pointer of the pointing device
14 (mouse 8); (λ, μ) represents the horizontal angle of view and vertical angle of view at the wide edge; and γ represents the current zoom relative magnification (magnification
10 information) assuming that the wide edge is one time ($\times 1$).

[0040]

In addition, as shown in Fig. 8B, a three-dimensional rotation matrix is generally expressed as follows.

[0041]

15 [Equation 2]

$$R_y(\phi) = \begin{bmatrix} \cos\phi & 0 & -\sin\phi \\ 0 & 1 & 0 \\ \sin\phi & 0 & \cos\phi \end{bmatrix}$$

$$R_z(\theta) = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

[0042]

Since the direction of one point (ξ, η) of a photographed picture that is panned and tilted by angular
20 information (θ, ϕ) from the home position is the same as the direction of one point (α, β) apart from the home position,

the following relation is satisfied.

[0043]

$$R_z(\theta) R_y(\phi) p = 1 R_z(\alpha) R_y(\beta) e_x$$

5 When the formula is solved with respect to p, the following relation is satisfied.

[0044]

[Equation 3]

$$p = 1 R_y(-\phi) R_z(\alpha - \theta) R_y(\beta) e_x$$

$$= 1 \begin{bmatrix} \cos(\alpha - \theta) \cos\phi \cos\beta + \sin\phi \sin\beta \\ \sin(\alpha - \theta) \cos\beta \\ -\cos(\alpha - \theta) \sin\phi \cos\beta + \cos\phi \sin\beta \end{bmatrix}$$

10

[0045]

Thereon,

[0046]

[Equation 4]

$$p = 1 \begin{bmatrix} a \\ b \\ c \end{bmatrix} \quad (3)$$

15

[0047]

Thus, ξ and η are obtained as follows.

[0048]

20

$$1 = 1/a$$

$$\xi = -1b / k_1 = -b / k_{1a}$$

$$\eta = 1c / k_2 = c / k_{2a}$$

With the above formula, (ξ, η) projected to the photograph coordinates can be obtained with coordinate data with an angle (α, β) from the home position.

5 [0049]

$$\xi = (-\sin(\alpha - \theta) \cos \beta) / (k_1 (\cos(\alpha - \theta) \cos \varphi \cos \beta + \sin \varphi \sin \beta))$$

$$\eta = (-\cos(\alpha - \theta) \sin \varphi \cos \beta + \cos \varphi \sin \beta) / (k_2 (\cos(\alpha - \theta) \cos \varphi \cos \beta + \sin \varphi \sin \beta))$$

10 Coordinate data (ξ, η) on the obtained picture by the pan tilter camera 3 can be obtained from angular coordinates (α, β) on the virtual spherical surface corresponding to coordinate (s, t) of a panorama picture. Thus, a panoreame picture can be generated.

15 [0050]

In contrast, coordinate data with an angle (α, β) can be obtained with (ξ, η) projected to photograph coordinates corresponding to the following formula.

[0051]

20 Since $1 = |p|$

$$a = 1 / \sqrt{1 + k_1^2 \xi^2 + k_2^2 \eta^2}$$

$$b = -k_1 \xi / \sqrt{1 + k_1^2 \xi^2 + k_2^2 \eta^2}$$

$$c = k_2 \eta / \sqrt{1 + k_1^2 \xi^2 + k_2^2 \eta^2}$$

where $\sqrt{(\)}$ represents that the square root of the calculated result in $(\)$ is obtained.

25

[0052]

Form Formula (3), the following relations are

satisfied.

$$a = \cos(\alpha - \theta) \cos \varphi \cos \beta + \sin \varphi \sin \beta$$

$$b = \sin(\alpha - \theta) \cos \beta$$

$$c = -\cos(\alpha - \theta) \sin \varphi \cos \beta + \cos \varphi \sin \beta$$

5 [0053]

Thus, the following relations are satisfied.

$$a \sin \varphi + c \sin \theta = \sin \beta$$

$$\tan(\alpha - \theta) = b / (a \cos \varphi - c \sin \theta)$$

Thus, the following relations are satisfied.

10
$$\beta = \sin^{-1} (\sin \varphi / \sqrt{(1 + k_1^2 \xi^2 + k_2^2 \eta^2)} + \sin \theta$$

$$k_2 \eta / \sqrt{(1 + k_1^2 \xi^2 + k_2^2 \eta^2)})$$

$$\alpha = \tan^{-1} (-k_1 \xi / (\cos \varphi - k_2 \eta \sin \theta)) + \theta$$

[0054]

Thus, the pan angle α and the tilt angle β can
15 be obtained as follows.

$$(\alpha, \beta) = (f(\xi, \eta, \theta, \varphi, \gamma), g(\xi, \eta, \theta, \varphi, \gamma))$$

... (4)

[0055]

If an error is permitted to some extent, (α, β)
20 can be expressed as follows.

[0056]

$$\alpha = \theta + (\lambda / \gamma) \times (\xi / N_y)$$

$$\beta = \varphi + (\mu / \gamma) \times (\eta / N_z)$$

In other words, Eq. (4) can be simplified as follows.

25
$$(\alpha, \beta) = (f(\xi, \theta, \gamma), g(\eta, \varphi, \gamma)) \quad \dots (5)$$

[0057]

Next, with reference to Fig. 9, a method for

calculating angular information (α, β) of the pan tilter 28 expressed by Eq. (4) and Eq. (5) with positional coordinates (ξ, η) of the operation area 6A will be described. First of all, an example of a method for directly designating a desired point in the operation area 6A will be described. Assuming that the center of the operation area 6A is defined as $(0, 0)$ of relative coordinates as shown in Fig. 9A, the positional coordinates (ξ, η) of the mouse pointer of the mouse 8 in the operation area 6A are obtained.

10 [0058]

Next, another method for designating a desired point generated with a desired area in the operation area 6A will be described. As shown in Fig. 9A, after a start point $(m1, n1)$ in a desired area is designated, an end point $(m2, n2)$ in the desired area is designated. As the coordinates at the center of the rectangle generated with these two points, a desired point (ξ, η) is obtained as Eq. (6).

15
$$(\xi, \eta) = ((m1, n1) + (m2, n2)) / 2 \quad \dots (6)$$

[0059]

20 Fig. 9A shows coordinates of the mouse 8 (pointing device 14) in the operation area 6A. In Fig. 9A, the moving range (y direction and z direction) of the mouse pointer of the mouse 8 in the operation area 6A is denoted by (Ny_1, Nz_1) . Angular coordinates (α, β) of the pan tilter 28 are obtained with positional coordinates (ξ, η) of the desired point (at the mouse pointer of the mouse 8), angular information (θ, ϕ) that represents the orientation of the pan tilter 28,

25

and magnification information (γ) of the current zoom relative magnification assuming that the wide edge of the zoom lens 16 is defined as one magnification corresponding to Eq. (4) or Eq. (5).

5 [0060]

The angular coordinates (α, β) shown in Fig. 9B are used to place a position designated by the pointing device to the center of the photographed screen assuming that the home position of the pan tilter 28 is defined as the origin of latitude and longitude.

[0061]

The coordinates obtained in Fig. 9 may be absolute coordinates of the screen of the monitor 2 or relative coordinates assuming that the center of the operation area 6A is defined as (0, 0). In the coordinates shown in Fig. 9, coordinates in the pan direction are represented by $\xi, m1, m2, \theta$, and α and coordinates in the tilt direction are represented by $\eta, n1, n2, \phi$, and β .

[0062]

20 Thus, when the mouse pointer of the mouse 8 is present in the operation area 6A, the angular information (α, β) of the pan tilter 28 is calculated with the angular information (θ, ϕ) of the current pan tilter 28 obtained with received data, the zoom magnification information (γ), and the positional information (ξ, η) at the mouse pointer of the mouse 8 corresponding to Eq. (4) or Eq. (5) so that the designated object is placed at the center of the operation

area 6A. The angular coordinates (α, β) of the pan tilter 28 are converted into internal positional information (p-new, t-new) as shown in Fig. 11. The resultant internal positional information (p-new, t-new) is stored in a send buffer along with an absolute position drive command of the pan tilter 28. In addition, as will be described later, a data send request flag (Flag-so) is set so that data is sent upon occurrence of a timer event.

[0063]

Next, with reference to Fig. 10, a method for converting positional coordinates (ξ, η) of the mouse pointer of the mouse 8 in the panorama operation area 6B of the panorama picture into angular coordinates (α, β) corresponding to the present invention will be described. As with the method for directly designating a desired point in the operation area 6A, as shown in Fig. 10A, with a method for directly designating a desired point in the panorama operation area 6B, positional coordinates (ξ, η) at the mouse pointer of the mouse 8 can be obtained.

[0064]

Next, another method for designating a desired point generated with a desired area in the panorama operation area 6B will be described. As shown in Fig. 10A, after a start point $(m1, n1)$ of a desired area is designated, the end point $(m2, n2)$ of the desired area are designated. Corresponding to Eq. (6), a desired point (ξ, η) is obtained.

[0065]

In Fig. 10A, the moving range (y direction and z direction) of the mouse pointer of the mouse 8 in the panorama operation area 6B (the moving range is defined as the coordinates of the mouse pointer of the mouse 8 (pointing device 14) in the panorama operation area 6B) is represented by (Ny_2, Nz_2) . The moving range is limited by the pan tilter limiter 6D denoted by dotted lines in the panorama operation area 6B. The pan tilter limiter 6D represents the moving range of the optical axis of the lens of the pan tilter camera 3. In other words, a point cannot be designated out of the pan tilter limiter 6D. Positional coordinates (x, y) in the panorama operation area 6B, angle-of-view information (s, t) , and angular information (α, β) of the pan tilter 28 can be obtained with the positional coordinates (ξ, η) of the desired point, the angular information (θ, φ) representing the orientation of the pan tilter 28, and the magnification information (γ) as the current zoom relative magnification assuming that the wide edge of the zoom lens 16 is defined as one magnification corresponding to Eq. (7), Eq. (8), and Eq. (9).

[0066]

$$(x, y) = (f_0(\theta), g_0(\varphi)) \quad \dots (7)$$

$$(s, t) = (f_1(\gamma), g_1(\gamma)) \quad \dots (8)$$

$$(\alpha, \beta) = (f(\xi), g(\eta)) \quad \dots (9)$$

In Fig. 10B, positional coordinates (x, y) represent the current orientation of the pan tilter 28 assuming that the home position of the pan tilter 28 is defined as the

origin of latitude and longitude. Angle-of-view information (s, t) is the current angle of view in the operation area 6A. Fig. 10B represents the states of the zoom lens and the pan tilter in the panorama operation area 6B.

5 [0067]

In Fig. 10C, angular coordinates (α, β) are used to place the position designated by the pointing device to the center of the photographed screen assuming that the home position of the pan tilter 28 is defined as the origin of latitude and longitude. (PragMax, TragMax) and (PragMin, TragMin) represent the moving range of the pan tilter (namely, the range represented by the pan tilter limiter 6D). Fig. 10C shows a drive target value in the pan tilter moving range.

[0068]

15 In Fig. 10, coordinates to be obtained may be absolute coordinates on the screen of the monitor 2 or relative coordinates assuming that the center of the panorama operation area 6B is defined as (0, 0). In the coordinates, coordinates in the pan direction are represented by $\xi, m1, m2, x, s$, and α and coordinates in the tilt direction are represented by $\eta, n1, n2, y, t$, and β .

[0069]

Thus, when the mouse pointer of the mouse 8 is present in the panorama operation area 6B, angular information (α, β) of the pan tilter 28 is calculated with positional information (ξ, η) at the mouse pointer of the mouse 8 corresponding to Eq. (9) so that the designated object in

the operation area 6A is placed at the center of the operation area 6A. Angular coordinates (α, β) of the pan tilter 28 are converted into internal positional information $(p\text{-new}, t\text{-new})$ of the pan tilter 28 corresponding to the method shown in Figs. 11A and 11B. The internal positional information $(p\text{-new}, t\text{-new})$ of the pan tilter 28 is stored in a send buffer along with an absolute position drive command of the pan tilter 28. In addition, as will be described later, a data send request flag (Flag-so) is set so that data is sent upon occurrence of the timer event.

[0070]

Next, a method for converting internal positional information (p, t) of the pan tilter 28 into angular information (θ, ϕ) and a method for converting angular coordinates (α, β) into internal positional information $(p\text{-new}, t\text{-new})$ of the pan tilter 28 will be described with reference to Fig. 11. In Fig. 11A, PragMin represents angular data at the left edge assuming that the home position of the pan tilter 28 is 0 (rag). PragMax represents angular data at the right edge assuming that the home position of the pan tilter 28 is 0 (rag). PdatMin represents internal count data at the left edge of the pan tilter controller 25. PdatMax represents internal counter data at the right edge of the pan tilter controller 25.

[0071]

To obtain the pan angle θ with the pan data p , since the following relation is satisfied,

$$\begin{aligned} & (\text{PragMax} - \theta) : (\text{PragMax} - \text{PragMin}) = (\text{PdatMax} \\ & - p) : (\text{PdatMax} - \text{PdatMin}) \end{aligned}$$

the pan angle θ is expressed as follows.

$$\begin{aligned} & \theta = \text{PragMax} - (\text{PragMax} - \text{PragMin}) \times (\text{PdatMax} - \\ 5 \quad & p) / (\text{PdatMax} - \text{PdatMin}) \end{aligned}$$

[0072]

Thus, the pan data p is expressed as follows.

$$\begin{aligned} & p = \text{PdatMax} - (\text{PragMax} - \theta) \times (\text{PdatMax} - \text{PdatMin}) \\ & / (\text{PragMax} - \text{PragMin}) \\ 10 \quad & [0073] \end{aligned}$$

In addition, to obtain the pan data p -new with the pan angle α , since the following relation is satisfied,

$$\begin{aligned} & (\text{PragMax} - \alpha) : (\text{PragMax} - \text{PragMin}) = (\text{PdatMax} \\ & - p\text{-new}) : (\text{PdatMax} - \text{PdatMin}) \\ 15 \quad & \text{the pan data } p\text{-new is expressed as follows.} \end{aligned}$$

$$\begin{aligned} & P\text{-new} = \text{PragMax} - (\text{PragMax} - \alpha) \times (\text{PdatMax} - \text{PdatMin}) \\ & / (\text{PragMax} - \text{PragMin}) \end{aligned}$$

[0074]

In Fig. 11B, TragMin represents angular data at the upper edge assuming that the home position of the pan
20 tilter 28 is 0 (rag). TragMax represents angular data at the lower edge assuming that the home position of the pan
tiler 28 is 0 (rag). TdatMin represents internal count data at the upper edge of the pan tilter controller 25. TdatMax
25 represents internal count data at the lower edge of the pan tilter controller 25.

[0075]

To obtain the tilt angle ϕ with the tilt data t , since the following relation is satisfied,

$$(\text{TragMax} - \phi) : (\text{TragMax} - \text{TragMin}) = (\text{TratMax} - t) : (\text{TdatMax} - \text{TdatMin})$$

5 the tilt angle ϕ is expressed as follows.

$$\phi = \text{TragMax} - (\text{TragMax} - \text{TragMin}) \times (\text{TdatMax} - t) / (\text{TdatMax} - \text{TdatMin})$$

[0076]

Thus, the tilt data t is expressed as follows.

10
$$t = \text{TdatMax} - (\text{TragMax} - \phi) \times (\text{TdatMax} - \text{TdatMin}) / (\text{TragMax} - \text{TragMin})$$

[0077]

To obtain the tilt data t -new with the tilt angle β , since the following relation is satisfied,

15
$$(\text{TragMax} - \beta) : (\text{TragMax} - \text{TragMin}) = (\text{TdatMax} - t\text{-new}) : (\text{TdatMax} - \text{TdatMin})$$

the tilt data T_{New} is expressed as follows.

$$T\text{-new} = \text{TragMax} - (\text{TragMax} - \beta) \times (\text{TdatMax} - \text{TdatMin}) / (\text{TragMax} - \text{TragMin})$$

20 [0078]

Next, with reference to Fig. 12, a method for converting positional coordinates (ξ, η) in the panorama operation area 6B into angular coordinates (α, β) of the pan tilter 28 and a method for converting angular information (θ, ϕ) of the pan tilter 28 into positional coordinates (x, y) in the panorama operation area 6B will be described. In Fig. 12A, PragMin represents angular data at the left edge

assuming that the home position of the pan tilter 28 is 0 (rag). PragMax represents angular data at the right edge assuming that the home position of the pan tilter 28 is 0 (rag). Ny₂ represents a horizontal coordinate of the panorama operation area 6B. -Ny₂ / 2 represents coordinate data at the left edge of the panorama operation area 6B. Ny₂ / 2 represents coordinate data at the right edge of the panorama operation area 6B.

[0079]

10 To obtain the pan angle α with the coordinate data ξ , since the following relation is satisfied,

$$(\text{PragMax} - \alpha) : (\text{PragMax} - \text{PragMin}) = (\text{Ny}_2 / 2 - \xi) : \text{Ny}_2$$

the pan angle α is expressed as follows.

15
$$\alpha = \text{PragMax} - (\text{PragMax} - \text{PragMin}) \times (\text{Ny}_2 / 2 - \xi) / \text{Ny}_2$$

[0080]

To obtain the coordinate data x with the pan angle θ , since the following relation is satisfied,

20
$$(\text{PragMax} - \theta) : (\text{PragMax} - \text{PragMin}) = (\text{Ny}_2 / 2 - x) : \text{Ny}_2$$

the coordinate data x is expressed as follows.

$$x = \text{Ny}_2 / 2 - (\text{PragMax} - \theta) \times \text{Ny}_2 / (\text{PragMax} - \text{PragMin})$$

[0081]

25 In Fig. 12B, TragMin represents angular data at the upper edge assuming that the home position of the pan tilter 28 is 0 (rag). TragMax represents angular data at

the lower edge assuming that the home position of the pan
tilter 28 is 0 (rag). Nz_2 represents a vertical coordinate
of the panorama operation area 6B. $-Nz_2 / 2$ represents
coordinate data at the upper edge of the panorama operation
area 6B. $Nz_2 / 2$ represents coordinate data at the lower
edge of the panorama operation area 6B.

[0082]

To obtain the tilt angle β with the coordinate
data η , since the following relation is satisfied,

$$(TragMax - \beta) : (TragMax - TragMin) = (Nz_2 / 2 - \eta) : Nz_2$$

the tilt angle β is expressed as follows.

$$\beta = TragMax - (TragMax - TragMin) \times (Nz_2 / 2 - \eta) / Nz_2$$

[0083]

To obtain the coordinate data y with the tilt angle
 ϕ , since the following relation is satisfied,

$$(TragMax - \phi) : (TragMax - TragMin) = (Nz_2 / 2 - y) : Nz_2$$

the coordinate data y is expressed as follows.

$$y = Nz_2 / 2 - (TragMax - \theta) \times Nz_2 / (TragMax - TragMin)$$

[0084]

Next, with reference to Fig. 13, a method for
converting angle-of-view information (ψ, ω) captured by the
pan tilter 28 into angle-of-view information (s, t) of the
frame 6C in the panorama operation area 6B will be described.
Fig. 13A shows the current angle-of-view information $(\psi,$

ω) of the pan tilter 28. The angle-of-view information (ψ , ω) is expressed as follows.

$$(\psi, \omega) = 1 / \gamma \times (\psi_0, \omega_0)$$

At this point, (ψ_0 , ω_0) represent the horizontal angle of view and the vertical angle of view at the wide edge. γ represents the magnification of the lens assuming that the wide edge is defined as one magnification.

[0085]

As shown in Fig. 13B, PragMin represents angular data at the left edge assuming that the home position of the pan tilter 28 is 0 (rag). PragMax represents angular data at the right edge assuming that the home position of the pan tilter 28 is 0 (rag). Ny_2 represents a horizontal coordinate of the panorama operation area 6B. $-Ny_2 / 2$ represents coordinate data at the left edge of the panorama operation area 6B. $Ny_2 / 2$ represents coordinate data at the right edge of the panorama operation area 6B.

[0086]

To obtain the horizontal angle of view s with the horizontal angle of view ψ , since the following relation is satisfied,

$$\psi : (\text{PragMax} - \text{PragMin}) = s : Ny_2$$

horizontal angle of view s is expressed as follows.

$$s = \psi \times Ny_2 / (\text{PragMax} - \text{PragMin})$$

[0087]

In Fig. 13C, TragMin represents angular data at the lower edge assuming that the home position of the pan

tilter 28 is 0 (rag). TragMax represents angular data at the upper edge assuming that the home position of the pan
tilter 28 is 0 (rag). Nz₂ represents a vertical coordinate
of the panorama operation area 6B. -Nz₂ / 2 represents
coordinate data at the lower edge of the panorama operation
area 6B. Nz₂ / 2 represents coordinate data at the upper
edge of the panorama operation area 6B.

[0088]

To obtain the vertical angle of view t with the
vertical angle of view ω, since the following relation is
satisfied,

$$\omega : (\text{TragMax} - \text{TragMin}) = t : \text{Nz}_2$$

the vertical angle of view t is expressed as follows.

$$t = \omega \times \text{Nz}_2 / (\text{TragMax} - \text{TragMin})$$

[0089]

Thus, the angle-of-view information (s, t) shown
in Fig. 13D is displayed as the frame 6C in the panorama
operation area 6B.

[0090]

Next, with reference to Fig. 14, a method for
converting the positional information (z) of the zoom lens
16 into magnification information (γ) will be described.
In Fig. 14, the vertical axis represents information of lens
magnification, whereas the horizontal axis represents the
internal information of zoom lens. The positional
information (z) of the zoom lens 16 is converted into the
magnification information (γ) by the computer 1 corresponding

to a conversion graph shown in Fig. 14. For example, the positional information (z) is converted into the magnification information (γ) corresponding to a ROM table or an equation.

[0091]

5 Next, with reference to Fig. 15, an example of a control algorithm of the computer 1 will be described. When the program is executed, the flow advances to step S1. At step S1, the operation area 6, the panorama operation area 6B, the cursor 7, and the pan tilter limiter 6D are
10 initialized and displayed on the monitor 2 as shown in Fig. 2. The range of the pan tilter limiter 6D may be fixed or variable. At step S2, a timer is set so that the computer 1 communicates with the mode controller 23 at predetermined intervals. After such initial setup operations have been
15 completed, the flow advances to step S3. At step S3, the system waits for an occurrence of an event. Corresponding to an event that occurs, the flow advances to a relevant step (for example, a timer event (at step S4), a mouse button down event (at step S5), a mouse button up event (at step
20 S6), and a mouse move event (at step S7)).

[0092]

 Next, with reference to a flow chart shown in Fig. 16, the algorithm of the timer event will be described. The timer event is an event for causing the computer 1 to communicate
25 with the mode controller 23 at predetermined intervals. The timer event occurs at intervals of for example 50 msec. When the timer event occurs, the flow advances to step S11. At

step S11, the system determines whether or not a communication port has been set. When the communication port has been set (namely, the determined result at step S11 is Yes), the flow advances to step S12. When the communication port has not been set (namely, the determined result at step S11 is No), the flow advances to step S18. At the first time the communication port has not been set, the flow advances to step S18. At step S18, the system opens the communication port. Actually, at step S18, the system opens an RS-232C port of the computer 1. Thereafter, the flow advances to step S16.

[0093]

Thereafter, in the timer event, the system performs a receive data checking process, an analyzing process, a data sending process for data stored in the send buffer (such as the drive command for the pan tilter 28), and/or a communication data sending process for state check requests for the pan tilter 28 and the zoom lens 16. In this algorithm, the flow advances from step S11 to step S12. At step S12, the system determines whether or not data is stored in the receive buffer. When data is stored in the receive buffer (namely, the determined result at step S12 is Yes), the flow advances to step S13. When data is not stored in the receive buffer (namely, the determined result at step S12 is No), the flow advances to step S14. At step S13, the system analyzes received data stored in the receive buffer and obtains positional information (p, t) of the pan tilter 28 and positional

information (z) of the zoom lens 16 that have been requested to the mode controller 23. The system converts the positional information (p, t) of the pan tilter 28 and the positional information (z) of the zoom lens 16 into angular information (θ, ϕ) of the pan tilter 28 and magnification information (γ) of the zoom lens 16 corresponding to methods shown in Fig. 11 and 14.

[0094]

At step S14, the system determines whether or not a data send request has been issued. When a data send request has been issued (Flag-so == True) (namely, the determined result at step S14 is Yes), the flow advances to step S19. At step S19, the system sends data stored in the send buffer and resets the send request flag (Flag-so == False). Next, the flow advances to step S16. An example of data stored in the send buffer is data of a drive command of the pan tilter 28 designated with the mouse 8. When a send request has not been issued (Flag-so == False) (namely, the determined result at step S14 is No), the flow advances to step S15. At step S15, the system sends position request commands for the pan tilter 28 and the zoom lens 16 from the computer 1 to the mode controller 23.

[0095]

At step S16, the system compares the old positional information of the pan tilter 28 with the new positional information thereof and determines whether or not the positional information (p, t) has varied. When the positional

information (p, t) of the pan tilter 28 has varied (namely, the determined result at step S16 is Yes), the flow advances to step S20. When the positional information (p, t) of the pan tilter 28 has not varied (namely, the determined result at step S16 is No), the flow advances to step S17. At step S17, the system compares the old positional information of the zoom lens 16 with the new positional information thereof and determines whether or not the positional information (z) has varied. When the positional information (z) of the zoom lens 16 has varied (namely, the determined result at step S17 is Yes), the flow advances to step S20. When the positional information (z) of the zoom lens 16 has not varied (namely, the determined result at step S17 is No), this event is completed.

[0096]

At step S20, when the positional information (p, t) of the pan tilter 28 and/or the positional information (z) of the zoom lens 16 has varied, the system redraws the frame 6C in the panorama operation area 6B. At this point, the system converts the positional information (p, t) of the pan tilter 28 into the angular information (θ, ϕ). In addition, the system converts the positional information (z) of the zoom lens 16 into the magnification information (γ). With the converted angular information (θ, ϕ) and magnification information (γ), the system calculates positional coordinates (x, y) of the pan tilter 28 and angle-of-view information (s, t) that is the angle of view

displayed in the operation area 6A corresponding to Eq. (7) and Eq. (8), respectively. Corresponding to the resultant positional coordinates (x, y) and angle-of-view information (s, t) , the system draws the frame 6C in the panorama operation area 6B.

[0097]

At step S16, the system compares the old positional information (p, t) of the pan tilter 28 with the new positional information (p, t) thereof. Alternatively, the system may compare the old angular information (θ, ϕ) of the pan tilter 28 with the new angular information (θ, ϕ) thereof. In this case, at step S20, with the new angular information (θ, ϕ) , the system calculates the positional coordinates (x, y) corresponding to Eq. (7). Likewise, at step S17, the system compares the old positional information (z) of the zoom lens 16 with the new positional information (z) thereof. Alternatively, the system may compare the old magnification information (γ) of the zoom lens 16 with the new magnification information (γ) thereof. In this case, at step S20, the system calculates the angular information (s, t) with the new magnification information (γ) corresponding to Eq. (8).

[0098]

Next, with reference to a flow chart shown in Fig. 17, the algorithm of the mouse move event will be described. The mouse move event is an event that occurs when the mouse 8 is moved. According to the present invention, the mouse move event is used to select a drive position of the pan

tilter28. When the mouse move event occurs, the flow advances to step S21. At step S21, the system determines whether or not the mouse pointer of the mouse 8 is present in the operation area 6A, the panorama operation area 6B, or the other area shown in Fig. 2. When the mouse pointer of the mouse 8 is present in the operation area 6A (namely, the determined result at step S21 is Yes), the flow advances to step S22. When the mouse pointer of the mouse 8 is not present in the operation area 6A (namely, the determined result at step S21 is No), the flow advances to step S24. At step S22, the system sets an operation area flag (Flag-rin == True) and clears a panorama operation area flag (Flag-pin == False).

[0099]

At step S24, since the mouse pointer of the mouse 8 is not present in the operation area 6A, the system clears the operation area flag (Flag-rin == False). At step S25, the system determines whether or not the mouse pointer of the mouse 8 is present in the panorama operation area 6B. When the mouse pointer of the mouse 8 is present in the panorama operation area 6B (namely, the determined result at step S25 is Yes), the flow advances to step S26. When the mouse pointer of the mouse 8 is not present in the panorama operation area 6B (namely, the determined result at step S25 is No), the flow advances to step S27. At step S26, the system sets the panorama operation area flag (Flag-pin == True). At step S27, since the mouse pointer of the mouse 8 is not present

in the panorama operation area 6B, the system clears the panorama operation area flag (Flag-pin == False).

[0100]

5 When the mouse pointer of the mouse 8 is present in the operation area 6A or the panorama operation area 6B (namely, the determined result at step S21 or step S25 is Yes), at step S23, the system obtains positional coordinates (ξ , η) of the mouse pointer of the mouse 8 assuming that the center of the operation area is defined as (0, 0) of relative coordinates.

[0101]

15 In this flow chart, when the mouse pointer of the mouse 8 is present in the operation area 6A (namely, the determined result at step S22 is Yes), the system sets the operation area flag (Flag-rin == True). When the mouse pointer of the mouse 8 is not present in the operation area 6A (namely, the determined result at step S22 is No), the system clears the operation area flag (Flag-rin == False). When the mouse pointer of the mouse 8 is present in the panorama operation area 6B (namely, the determined result at step S25 is Yes), the system sets the panorama operation area flag (Flag-pin == True). When the mouse pointer 8 is not present in the panorama operation area 6A (namely, the determined result at step S25 is No), the system clears the panorama operation area flag (Flag-pin == False). When the mouse pointer of the mouse 8 is present in the operation area 6A or the panorama operation area 6B (namely, the determined result at step

S21 or S35 is Yes), the system designates the positional coordinates of the mouse pointer of the mouse 8 to (ξ, η) assuming that the center of each operation area is defined as (0, 0) of relative coordinates.

5 [0102]

Next, the mouse button down event and the button up event will be described. In the method for directly designating a desired point of the operation area 6A or the panorama operation area 6B, only the algorithm of a mouse button down event shown in Fig. 18 is used. In the method for designating a desired point generated with a desired area, both the algorithm of a mouse button down event shown in Fig. 19 and the algorithm of a mouse button up event shown in Fig. 20 are used.

15 [0103]

With reference to a flow chart shown in Fig. 18, the algorithm of the button down event for the method for directly designating a desired point of the operation area will be described. This event is an event that occurs when the left button of the mouse 8 is pressed. In the present invention, this event is used as trigger information for driving the pan tilter 28. When this event occurs, the flow advances to step S31. At step S31, the system determines whether or not the mouse pointer 8 is present in the operation area 6A corresponding to the operation area flag. When the operation area flag has been set (Flag-rin == True) (namely, the determined result at step S31 is Yes), since the mouse

pointer of the mouse 8 is present in the operation area 6A,
the flow advances to step S32. When the operation area flag
has been cleared (Flag-rin == False) (namely, the determined
result at step S31 is No), since the mouse pointer of the
5 mouse 8 is not present in the operation area 6A, the flow
advances to step S34.

[0104]

When the mouse pointer of the mouse 8 is present
in the operation area 6A (namely, the determined result at
10 step S31 is Yes), the flow advances to step S32. At step
S32, the system calculates angular information (α , β) of
the pan tilter 28 with the angular information (θ , ϕ) of the
current pan tilter 28 obtained from the received data, the
magnification information (γ) of the zoom lens 16, and the
15 positional coordinate (ξ , η) of the mouse pointer of the
mouse 8 in the operation area 6A corresponding to Eq. (4)
or Eq. (5) so that the designated object in the operation
area is placed at the center of the screen.

[0105]

20 At step S33, the system converts the angular
information (α , β) of the pan tilter 28 into the internal
positional information (p-new, t-new) corresponding to the
method shown in Fig. 11. The system stores the converted
positional information (PNew, TNew) in the send buffer along
25 with the absolute position drive command of the pan tilter
28. In addition, the system sets the data send request flag
(FlagSo == True) and sends the data with the process of the

timer event.

[0106]

After the system has determined that the mouse pointer of the mouse 8 is not present in the operation area 6A (namely, the determined result at step S31 is No), the flow advances to step S34. At step S34, the system determines whether or not the mouse pointer of the mouse 8 is present in the panorama operation area 6B corresponding to the panorama operation area flag. When the panorama operation flag has been set (Flag-pin == True) (namely, the determined result at step S34 is Yes), since the mouse pointer of the mouse 8 of the panorama operation area 6B is present in the panorama operation area 6B, the flow advances to step S35. When the panorama operation flag has been cleared (Flag-pin == False) (namely, the determined result at step S34 is No), this event is completed.

[0107]

In this flow chart, the system determines whether or not the mouse pointer of the mouse 8 is present in the operation area 6A or the panorama operation area 6B corresponding to the operation area flag (Flag-rin) and the panorama operation area flag (Flag-pin). When the mouse pointer of the mouse 8 is not present in the operation area 6A and the panorama operation area 6B, this event becomes invalid.

[0108]

When the mouse pointer of the mouse 8 is present

in the panorama operation area 6B (namely, the determined result at step S34 is Yes), the flow advances to step S35. At step S35, the system calculates angular information (α , β) of the pan tilter 28 with the positional information (ξ , η) at the mouse pointer of the mouse 8 in the panorama operation area 6B corresponding to Eq. (9) so that the designated object in the operation area is placed at the center of the screen. Thereafter, the flow advances to step S33.

[0109]

Next, with reference to Figs. 19 and 20, the algorithms of the button down event and the button up event for the method for designating a desired point generated with a desired area in the panorama operation area 6B will be described, respectively.

[0110]

With reference to the flow chart shown in Fig. 19, the algorithm of the button down event will be described. This event is an event that occurs when the left button of the mouse 8 is pressed. In this embodiment, this event is used as an event for determining the start point of a desired area. When this event occurs, the flow advances to step S41. At step S41, the system determines whether or not the mouse pointer of the mouse 8 is present in the operation area 6A corresponding to the operation area flag (Flag-rin). When the operation area flag has been set (Flag-rin == True) (namely, the determined result at step S41 is Yes), since the mouse pointer of the mouse 8 is present in the operation

area 6A, the flow advances to step S42. When the operation area flag has been cleared (Flag-rin == False) (namely, the determined result at step S41 is No), since the mouse pointer of the mouse 8 is not present in the operation area 6A, the flow advances to step S44.

[0111]

When the mouse pointer of the mouse 8 is present in the operation area 6A (namely, the determined result at step S41 is Yes), at step S42, the system sets an operation areastartpointobtainflag (Flag-rstart=True). Thereafter, the flow advances to step S43. At step S43, the system stores positional coordinates (m1, n1) at which the left button of the mouse 8 is pressed as the start point of the desired area.

[0112]

After the system has determined that the mouse pointer of the mouse 8 is not present in the operation area 6A, at step S44, the system determines whether or not the mousepointerofthemouse8ispresentinthe panoramaoperation area 6B corresponding to the panorama operation area flag (Flag-pin). When the panorama operation area flag has been set (Flag-pin == True) (namely, the determined result at step S44 is Yes), since the mouse pointer of the mouse 8 ispresentinthe panoramaoperationarea 6B, the flow advances to step S45. When the panorama operation area flag has been cleared (Flag-pin == False) (namely, the determined result at step S44 is No), this event is completed.

[0113]

In this flow chart, the system determines whether or not the mouse pointer of the mouse 8 is present in the operation area 6A or the panorama operation area 6B corresponding to the operation area flag (Flag-rin) and the
5 panorama operation area flag (Flag-pin). When the mouse pointer of the mouse 8 is not in the operation area 6A and the panorama operation area 6B, this event becomes invalid.

[0114]

10 When the mouse pointer of the mouse 8 is present in the panorama operation area 6B (namely, the determined result at step 44 is Yes), the flow advances to step S45. At step S45, the system sets a panorama operation area start point obtain flag (Flag-pstart). Thereafter, the flow
15 advances to step S43.

[0115]

Next, with reference to a flow chart shown in Fig. 20, the algorithm of the button up event will be described. This event is an event that occurs when the left button of
20 the mouse 8 is released. In the present invention, the button up event is used as an event for determining the end point of a desired area.

[0116]

When this event occurs, the flow advances to step
25 S51. At step S51, the system determines whether or not the operation area flag has been set (Flag-rin == True) (namely, the mouse pointer of the mouse 8 is present in the operation

area 6A). When the operation area flag has been set (Flag-rin = True) (namely, the determined result at step S51 is Yes), since the mouse pointer of the mouse 8 is present in the operation area 6A, the flow advances to step S52. When the operation area flag has been cleared (Flag-rin == False) (namely, the determined result at step S51 is No), since the mouse pointer of the mouse 8 is not present in the operation area 6A, the flow advances to step S57. At step S52, the system determines whether or not the left button of the mouse 8 has been pressed in the operation area 6A corresponding to an operation area start point obtain flag (Flag-rstart). When the start point obtain flag has been set (Flag-rstart == True) (namely, the determined result at step S52 is Yes), since the left button of the mouse 8 has been pressed in the operation area 6A, the flow advances to step S53. When the start point obtain flag has been cleared (Flag-rstart == False) (namely, the determined result at step S52 is No), since the left button of the mouse 8 has not been pressed in the operation area 6A, the flow advances to step S57.

[0117]

In other words, at steps S51 and S52, the system determines whether or not the operation area flag and the operation area start point obtain flag have been set or cleared. When the operation area flag and the start point obtain flag have been set (Flag-rin == True and Flag-rstart == True), the system determines that the drive command has taken place in the operation area 6A. Otherwise, at steps S57 and S58,

the system determines whether or not the panorama operation area flag (Flag-pin) and the panorama operation area start point obtain flag (Flag-pstart) have been set or cleared.

[0118]

5 When the drive command has taken place in the operation area (namely, the operation area flag and the start point obtain flag have been set (Flag-rin==True and Flag-rstart == True), at step S53, the system stores the positional coordinates (m2, n2) at which the left button of the mouse
10 8 has been released in the operation area 6A as the end point of the desired area. Thereafter, the system calculates positional information (ξ , η) as the coordinates of the center of the rectangle area generated with the positional coordinates (m1, n1) of the start point of the desired area and the positional
15 coordinates (m2, n2) of the end point thereof.

[0119]

 At step S54, the system calculates angular information (α , β) of the pan tilter 28 with the angular information (θ , φ) of the pan tilter obtained from the received
20 data, the magnification information (γ) of the zoom lens 16, and the positional information (ξ , η) at the mouse pointer of the mouse 8 corresponding to Eq. (4) or Eq. (5).

[0120]

 At step S55, the system converts the angular
25 information (α , β) of the pan tilter 28 into the internal positional information (p-new, t-new) of the pan tilter 28 corresponding to the method shown in Fig. 11 and stores the

positional information (p-new, t-new) to the send buffer
alongwiththeabsolute positiondrive command. In addition,
the system sets the data send request flag (Flag-so == True)
and sends data with the process of the timer event.

5 [0121]

At step S56, after the system has checked the mouse
button up event in each operation area, the system clears
the operation area start point obtain flag and the panorama
operation area start point obtain flag (Flag-rstart == False
10 and Flag-pstart == False). Thereafter, this event is
completed.

[0122]

At step S57, the system determines whether or not
the mouse pointer of the mouse 8 is present in the panorama
15 operation area 6B corresponding to the panorama operation
area flag (Flag-pin). When the panorama operation area flag
has been set (Flag-pin == True) (namely, the determined result
at step S57 is Yes), since the mouse pointer of the mouse
8 is present in the panorama operation area 6B, the flow
20 advances to step S58. When the panorama operation area flag
has not been set (Flag-pin == False), since the mouse pointer
of the mouse 8 is not present in the panorama operation area
6B, the flow advances to step S56. At step S58, the system
determines whether or not the left button of the mouse 8
25 has been pressed in the panorama operation area 6B corresponding
to the panorama operation area start point obtain flag
(Flag-pstart). When the start point obtain flag has been

set (Flag-pstart == True) (namely, the determined result at step S58 is Yes), since the left button of the mouse 8 has been pressed in the panorama operation area 6B, the flow advances to step S59. When the start point obtain flag has not been set (Flag-pstart == False) (namely, the determined result at step S58 is No), since the left button of the mouse 8 has not been pressed in the panorama operation area 6B, the flow advances to step S56.

[0123]

When the panorama operation area flag and the panorama operation start point obtain flag have been set (FlagPin == True and FlagPstart == True) at steps S57 and S58, the system determines that a drive command has issued in the panorama operation area 6B. When the conditions at steps S51, S52, and S58 are not satisfied, this event becomes invalid.

[0124]

Whenthe drivecommandhasbeenissuedinthe panorama operation area 6B (namely, the panorama operation area flag and the start obtain flag have been set (Flag-pin == True and Flag-pstart == True), the flow advances to step S59. At step S59, the system stores the positional coordinates (m2, n2) at which the left button of the mouse 8 has been released in the panorama operation area 6B as the end point of the desired area. The system calculates the positional information (ξ , η) of the mouse pointer of the mouse 8 as the coordinates of the center of the rectangle area with

the positional coordinates ($m1$, $n1$) of the start point of the desired area that has been stored and the positional coordinates ($m2$, $n2$) of the end point of the desired area corresponding to Eq. (6).

5 [0125]

At step S60, the system calculates angular information (α , β) of the pan tilter 28 with the positional information (ξ , η) at the mouse pointer of the mouse 8 in the panorama operation area 6B corresponding to Eq. (9) so that the designated object in the panorama operation area is placed at the center of the screen. Thereafter, the flow advances to step S55.

[0126]

In the first embodiment, whenever the pan tilter camera 3 sends a picture to the computer 1, the computer 1 combines it and displays the combined picture in the panorama operation area 6B. Alternatively, after the computer has combined all pictures, it may display the resultant picture in the panorama operation area 6B.

20 [0127]

According to the first embodiment, the computer 1 forms a panorama picture. Alternatively, the server 9 may form a panorama picture and send the data of the panorama picture to the computer 1 through a low capacity network line, and display the picture in the panorama operation area 6B of the monitor 2.

[0128]

According to the first embodiment, the operation area 6A and the panorama operation area 6B are displayed on the monitor 2 connected to the computer 1. Alternatively, the operation area 6A and/or the panorama operation area 6B may be displayed on another display unit other than the monitor 2.

[0129]

According to the first embodiment, the pan tilter camera 3 is driven by operating the operation area 6A and the panorama operation area 6B with the mouse 8. Alternatively, one of the operation area 6A and the panorama operation area 6B may be operated with the mouse 8.

[0130]

According to the first embodiment, the operation area 6A and the panorama operation area 6B are displayed on the monitor 2. Alternatively, only the panorama operation area 6B may be displayed on the monitor 2.

[0131]

According to the first embodiment, the operation area 6A and the panorama operation area 6B are displayed on the monitor 2. By operating the operation area 6A and the panorama operation area 6B with the mouse 8, the pan tilter camera 3 is freely driven. Alternatively, a panorama picture may be displayed on the monitor 2. In this case, the pan tilter camera 3 may be driven with an operation portion such as eight-direction keys.

[0132]

According to these second embodiment, for simplicity,
one computer 1 is connected to the remote server 9 and the
pan tilt camera 3 that are disposed at a remote place.
Alternatively, a plurality of servers 9 and a plurality of
5 pan tilt cameras 3 may be disposed worldwide. For example,
one pan tilt camera 3 may be controlled by a plurality
of computers through Internet, for example.

[0133]

According to the above-described embodiments, the
10 photographing range of the pan tilt camera 3 may be the
maximum moving range of the pan tilt camera 3 or limited
with a limiter. The function for limited the photographing
range with the limiter may be provided by the pan tilt
camera 3 or the computer 1.

15 [0134]

In the first embodiment, a desired point generated
with a desired area is placed at the center of thereof.
Alternatively, a desired point may be placed at for example
the center of gravity, the incenter, the circumcenter, or
20 the orthocenter of the area.

[0135]

According to the first embodiment, a panorama
picture displayed in the panorama operation area 6B is not
limited as long as it represents the environment in which
25 the pan tilt camera 3 is disposed. For example, the panorama
picture may be a moving picture, an intermittent still picture,
or a still picture.

[0136]

[Effects of the Invention]

According to the present invention, a desired object can be displayed at the center of the operation area with the clicking operation of the mouse. In addition, since the position to which the pan tilter moves can be predicted beforehand, on a communication line that causes picture and information data to be delayed and/or lost (such as Internet), the user can seamlessly operate the pan tilter camera. Thus, according to the present invention, the pan tilter camera can be easily operated with high visibility.

[0137]

According to the present invention, with a panorama picture, the user can see the environment in which the photographing apparatus is disposed at a glance. Since the positional information of the pan tilter, the angle of view of the zoom lens, and the moving range of the pan tilter are added as information to the picture, the user can easily know the state of the photographing apparatus. In addition, when the user designates a desired object in the panorama operation area, he or she can easily capture it in the field of view of the picture to be photographed. Moreover, by designating an object in the operation area, the user can precisely adjust the position that cannot be designated in the panorama operation area.

[Brief Description of the Drawings]

[Fig. 1]

An external view for explaining a system according to the present invention.

[Fig. 2]

5 A schematic diagram for explaining a screen according to the present invention.

[Fig. 3]

A block diagram showing the structure of the system according to the embodiment of the present invention.

[Fig. 4]

10 A schematic diagram for explaining a method for generating a panorama picture according to the present invention.

[Fig. 5]

15 A schematic diagram for explaining a method for generating a panorama picture according to the present invention.

[Fig. 6]

20 A schematic diagram for explaining a method for generating a panorama picture according to the present invention.

[Fig. 7]

25 A schematic diagram for explaining a method for generating angular information of a pan tilt camera with positional coordinates in a panorama operation area according to the present invention.

[Fig. 8]

A schematic diagram for explaining a plane -

spherical surface converting method according to the present invention.

[Fig. 9]

5 A schematic diagram for explaining a coordinate converting method in the operation area according to the present invention.

[Fig. 10]

10 A schematic diagram for explaining a coordinate converting method in the panorama operation area according to the present invention.

[Fig. 11]

A schematic diagram for explaining positional information and angular information of a pan tilter camera according to the present invention.

15 [Fig. 12]

A schematic diagram for explaining angular coordinates of the pan tilter camera and positional coordinates in the panorama operation area according to the present invention.

20 [Fig. 13]

A schematic diagram for explaining the angle of view of the pan tilter camera and a frame in the panorama operation area according to the present invention.

[Fig. 14]

25 A graph for explaining a conversion method of zoom data and magnification data according to the present invention.

[Fig. 15]

A flow chart showing an example of the overall process according to the present invention.

[Fig. 16]

5 A flow chart showing an example of the process of a timer event according to the present invention.

[Fig. 17]

A flow chart showing an example of the process of a mouse moving event according to the present invention.

[Fig. 18]

10 A flow chart showing an example of the process of a mouse button down event according to the present invention.

[Fig. 19]

A flow chart showing another example of the process of a mouse button down event according to the present invention.

15 [Fig. 20]

A flow chart showing an example of the process of a mouse up/down event according to the present invention.

[Fig. 21]

20 A system through the conventional transmission path.

[Description of Reference Numerals]

1 ... Computer, 2 ... Monitor, 6A ... Operation area, 6B ...
Panorama operation area, 7 ... Cursor, 9 ... Server, 11 ...
Camera portion, 12 ... Pan tilter portion, 13 ... TV monitor,
25 14 ... Pointing device, 15 ... Lens block, 16 ... Zoom lens,
17 ... Zoom portion, 18, 26, 27 ... Motor, 19 ... Solid
state image pickup device, 20 ... Signal separating/automatic

gain adjusting circuit, 21 ... A/D converter, 22 ... Signal
processing, 23 ... Mode controller, 24 ... Camera controller,
25 ... Pan tilter controller, 28 ... Pan tilter, 29 ... Video
capture, 30 ... Storing portion, 31 ... Controlling portion

[Title of Document] Abstract

[Abstract]

[Subject]

5 To easily obtain a desired picture by displaying
a part or whole of the moving range of a pan tilter camera
that is connected through a transmission path as a panorama
picture and designating a desired position or a desired area
on the panorama picture.

[Solving Means]

10 A picture photographed by a camera portion 11 is
sent to a video capturing portion 29 of a computer 1. The
picture is displayed in an operation area 6A of a monitor
2. A panorama picture of which pictures in part or all moving
range of a pan tilter 28 are combined is displayed in a panorama
15 operation area 6B. A pan tilter portion 12 sends positional
information of pan and tilt to the computer 1 through a mode
controller 23. With a mouse 8, the operation area 6A and
6B are operated so as to the computer 1 obtain data for driving
the pan tilter 28. Thus, the selected object is displayed
20 at the center of the operation area.

[Selected Drawing] Fig. 3

25

Translation of Drawings

FIG. 1

3 ... PAN TILTER CAMERA
5 9 ... SERVER

FIG. 2

6A ... OPERATION AREA
6B ... PANORAMA OPERATION AREA
10

FIG. 3

(A) ... VIDEO SIGNAL
(B) ... DRIVE COMMAND
(C) ... POSITIONAL INFORMATION
15 (D) ... CONTROL, POSITIONAL INFORMATION
(E) ... ZOOM
15 ... LENS BLOCK
22 ... SIGNAL PROCESSING
11 ... CAMERA PORTION
20 13 ... TV MONITOR
28 ... PAN TILTER
26 ... PAN MOTOR
27 ... TILT MOTOR
24 ... CAMERA CONTROLLER
25 25 ... PAN TILTER CONTROLLER
23 ... MODE CONTROLLER
2 ... MONITOR

6A ... OPERATION AREA
6B ... PANORAMA OPERATION AREA
9 ... SERVER
31 ... CONTROLLING PORTION
5 29 ... VIDEO CAPTURE
30 .. STORING PORTION
1 ... COMPUTER
14 ... POINTING DEVICE

10 FIG. 6

(1) ... PICTURE CONVERTED INTO SPHERICAL SURFACE IS
NORMALIZED WITH LATITUDE AND LONGITUDE
(2) ... CAPTURED PICTURE
(3) ... OBTAINED PICTURE

15

FIG. 7

(1) ... PAN ANGLE
(2) ... COORDINATE DATA
(3) ... TILT ANGLE
20 (4) ... COORDINATE DATA

FIG. 11A

(1) ... PAN ANGLE
(2) ... PAN DATA

25

FIG. 11B

(1) ... TILT ANGLE

(2) ... TILT DATA

FIG. 12A

(1) ... PAN ANGLE

5 (2) ... COORDINATE DATA

FIG. 12B

(1) ... TILT ANGLE

(2) ... COORDINATE DATA

10

FIG. 13A

(1) ... HORIZONTAL ANGLE OF VIEW (ψ)

(2) ... VERTICAL ANGLE OF VIEW (ω)

15 FIG. 13B

(1) ... PAN ANGLE

(2) ... COORDINATE DATA

FIG. 13C

20 (1) ... PAN ANGLE

(2) ... COORDINATE DATA

FIG. 13D

(1) ... HORIZONTAL ANGLE OF VIEW (s)

25 (2) ... VERTICAL ANGLE OF VIEW (t)

FIG. 14

(1) ... INFORMATION OF LENS MAGNIFICATION

(2) ... INTERNAL INFORMATION OF ZOOM LENS

FIG. 15

(A) ... START

5 S1 ... INITIALIZE OPERATION AREA ON MONITOR.

S2 ... SET TIMER EVENT.

S3 ... DETERMINE TYPE OF EVENT THAT OCCURS.

S4 ... TIMER EVENT

S5 ... MOUSE BUTTON DOWN EVENT

10 S6 ... MOUSE BUTTON UP EVENT

S7 ... MOUSE MOVE EVENT

FIG. 16

(A) ... START

15 (B) ... NO

(C) ... YES

(D) ... NO

(E) ... YES

(E)' ... YES (TRUE)

20 (E)" ... NO (FALSE)

(F) ... YES

(G) ... NO

(H) ... YES

(I) ... NO

25 (J) ... END

S11 ... HAS COMMUNICATION PORT BEEN SET ?

S12 ... IS DATA STORED IN RECEIVE BUFFER ?

S13 ... ANALYZE RECEIVE DATA, OBTAIN PAN TILTER POSITION
 (p, t) AND ZOOM POSITION (z), AND CALCULATE PAN TILTER ANGLE
 (θ , φ) AND ZOOM MAGNIFICATION (γ).
 S14 ... IS SEND REQUEST FLAG Flag-So TRUE ?
 5 S15 ... SEND PAN TILER, ZOOM POSITION REQUEST COMMUNICATION
 DATA.
 S18 ... SET COMMUNICATION PORT.
 S19 ... SEND DATA STORED IN SEND BUFFER AND RESET Flag-So
 TO FALSE.
 10 S16 ... HAS PAN TILTER DATA VARIED ?
 S17 ... HAS ZOOM DATA VARIED ?
 S20 ... REDRAW FRAME IN PANORAMA PICTURE AREA.

 FIG. 17
 15 (A) ... START
 (B) ... NO
 (C) ... YES
 (D) ... NO
 (E) ... YES
 20 (F) ... END
 S21 ... IS MOUSE POINTER PRESENT IN OPERATION AREA ?
 S23 ... OBTAIN COORDINATES (ξ , η) OF POSITION OF MOUSE POINTER
 IN OPERATION AREA.
 S25 ... IS MOUSE POINTER PRESENT IN PANORAMA OPERATION AREA ?
 25 FIG. 18
 (A) ... START
 (B) ... NO (FALSE)

(C) ... YES (TRUE)
 (D) ... NO (FALSE)
 (E) ... YES (TRUE)
 (F) ... END

5 S32 ... OBTAIN (α , β) WITH EACH DATA.
 S33 ... CONVERT (α , β) INTO PANTILTER POSITIONAL COORDINATES
 (P-New, T-New), STORE THEM AS ABSOLUTE POSITION DRIVE REQUEST
 COMMUNICATION DATA TO COMMUNICATION BUFFER, AND SET Flag-So
 TO TRUE.

10 S35 ... OBTAIN (α , β) WITH EACH DATA.

FIG. 19

(A) ... START
 (B) ... NO (FALSE)
 15 (C) ... YES (TRUE)
 (D) ... NO (FALSE)
 (E) ... YES (TRUE)
 (F) ... END

S42 ... SET START POINT OBTAIN FLAG Flag-Rstart TO TRUE.

20 S43 ... OBTAIN COORDINATES (m1, n1) AT THE POINT.
 S45 ... SET START POINT OBTAIN FLAG Flag-Pstart TO TRUE.

FIG. 20

(A) ... START
 25 (B) ... NO (FALSE)
 (C) ... YES (TRUE)
 (D) ... NO (FALSE)

(E) ... YES (TRUE)
 (F) ... NO (FALSE)
 (G) ... YES (TRUE)
 (H) ... NO (FALSE)
 5 (I) ... YES (TRUE)
 (J) ... END

 S53 ... OBTAIN COORDINATES (m_2 , n_2) AND THEREBY (ξ , η) AT
 THIS POINT.

 S54 ... OBTAIN (α , β) WITH EACH DATA.
 10 S55 ... CONVERT (α , β) INTO PANTILTER POSITIONAL COORDINATES
 (P-New, T-New), STORE THEM AS ABSOLUTE POSITION DRIVE REQUEST
 COMMUNICATION DATA TO COMMUNICATION BUFFER, AND SET Flag-So
 TO TRUE.

 S56 ... SET START POINT OBTAIN FLAG Flag-RStart TO FALSE
 15 AND Flag-Pstart TO FALSE.

 S59 ... OBTAIN COORDINATES (m_2 , n_2) AND THEREBY (ξ , η) AT
 THIS POINT.

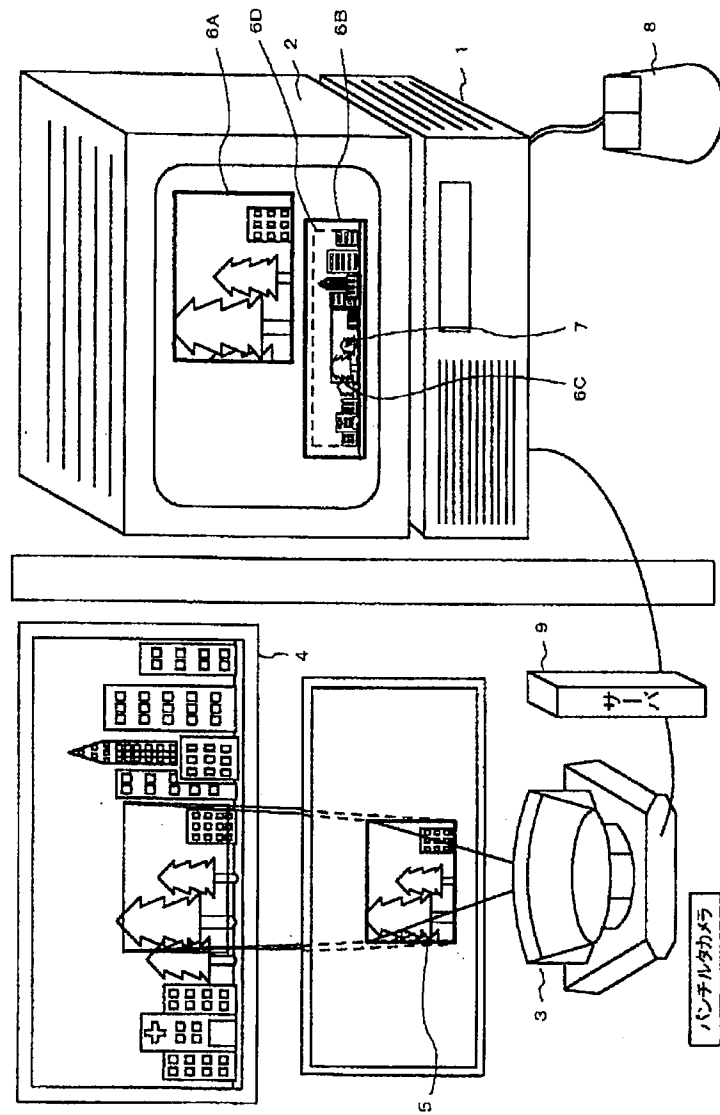
 S60 ... OBTAIN (α , β) WITH EACH DATA.

 20 FIG. 21

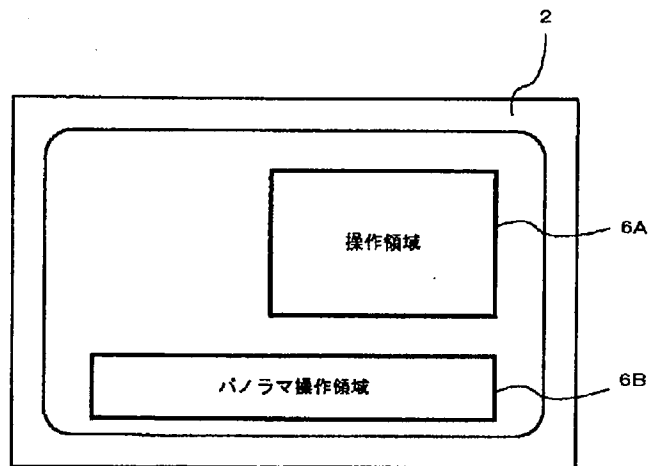
 3 ... PAN TILTER CAMERA
 9 ... SERVER

【書類名】 図面

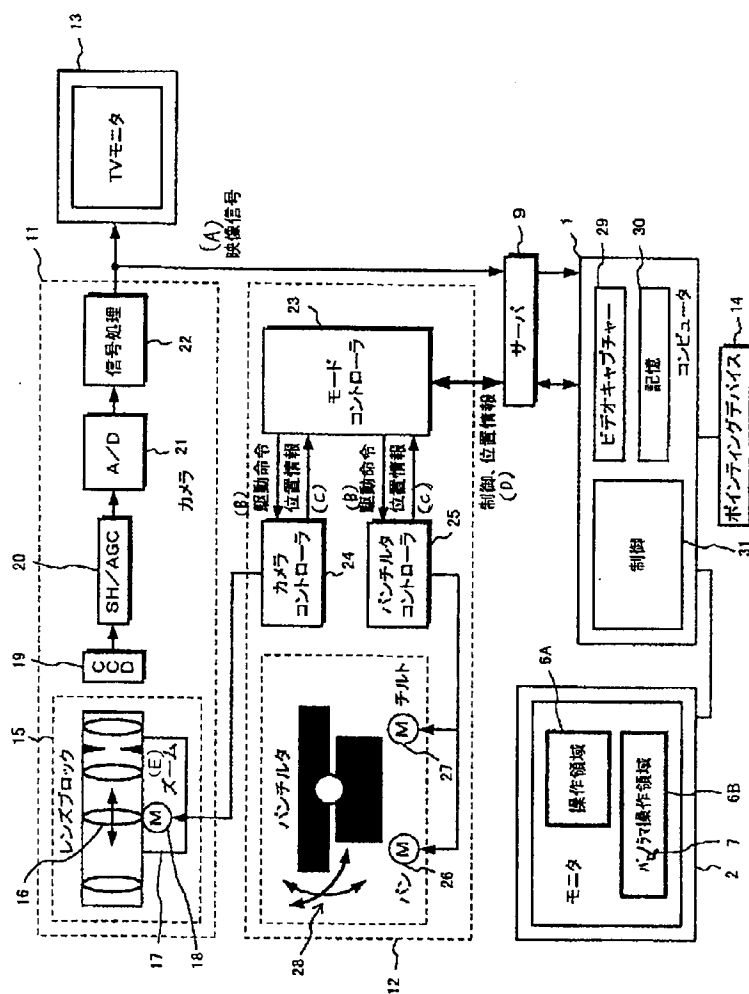
【図 1】



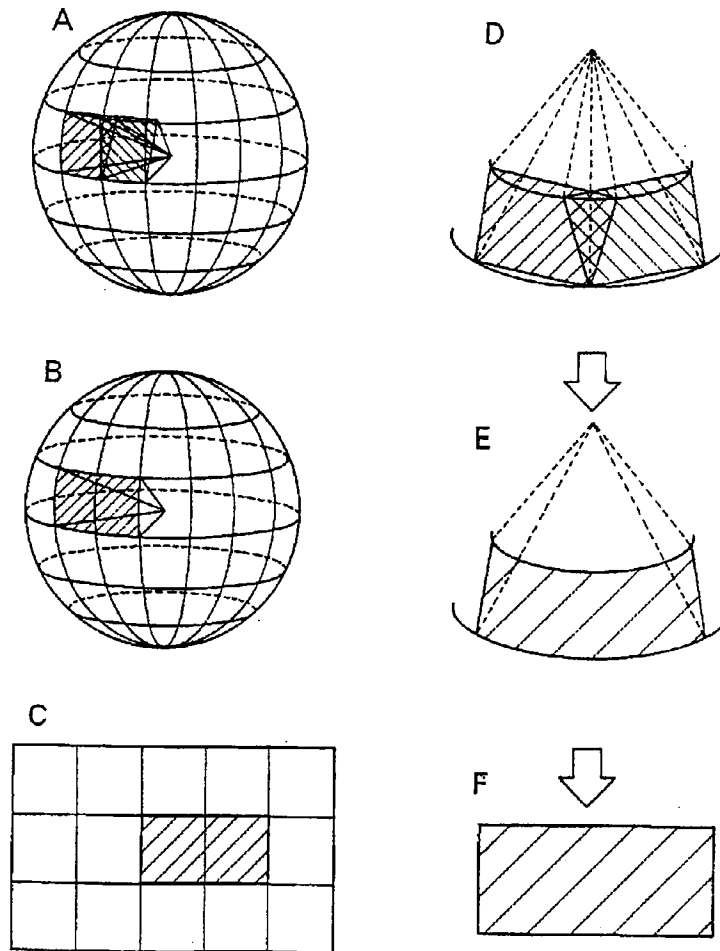
【図 2】



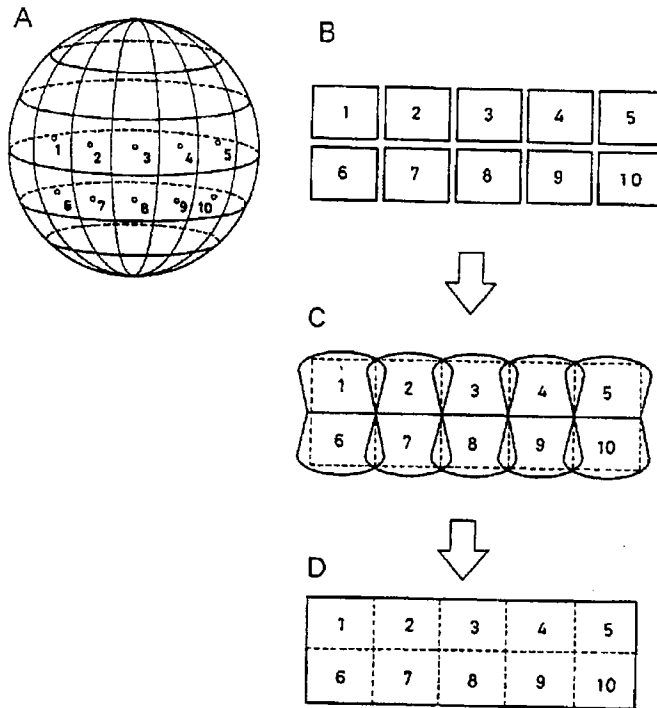
【図 3】



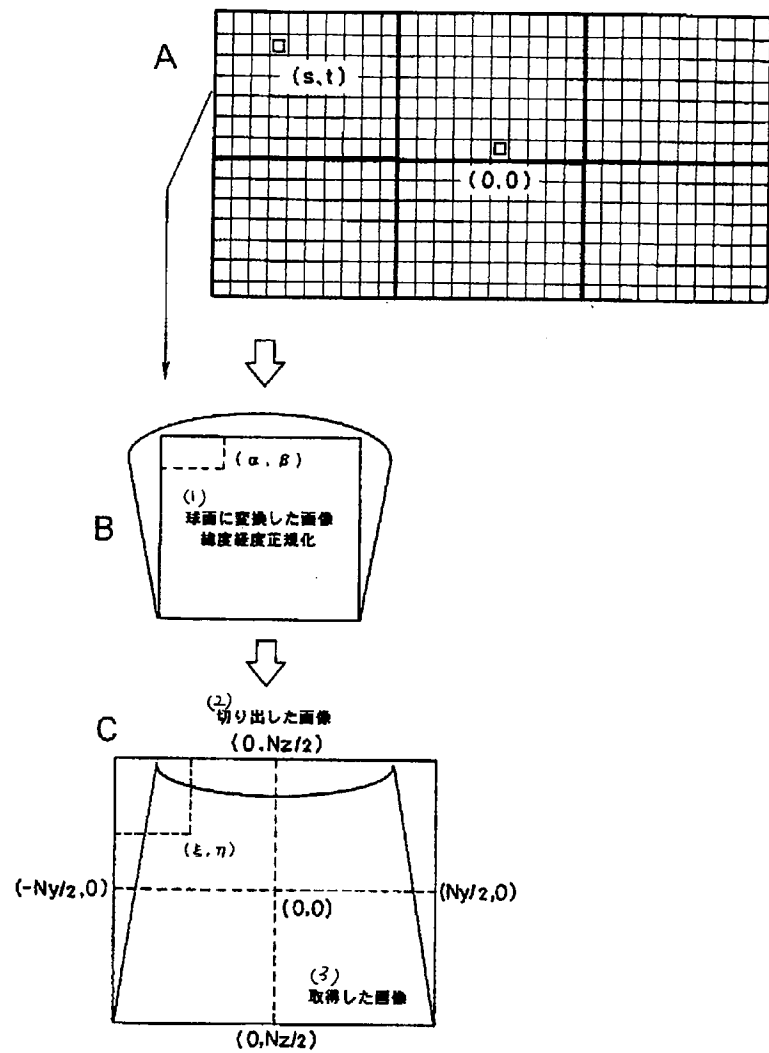
【図 4】



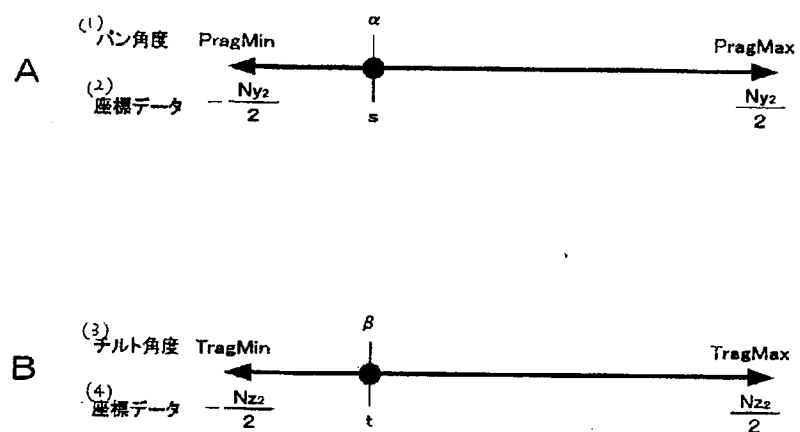
【図 5】



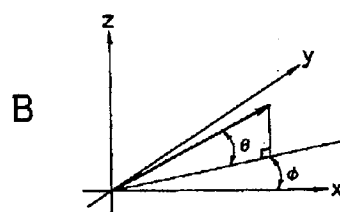
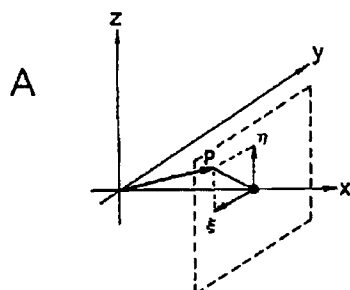
【図 6】



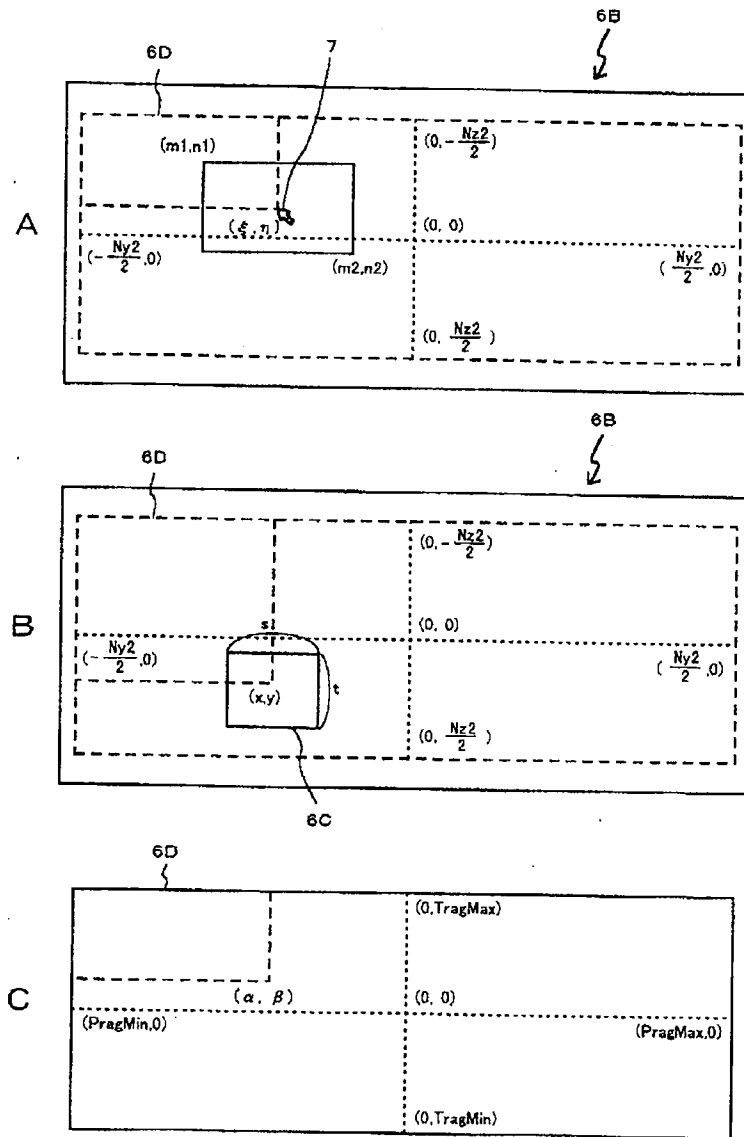
【 図 7 】



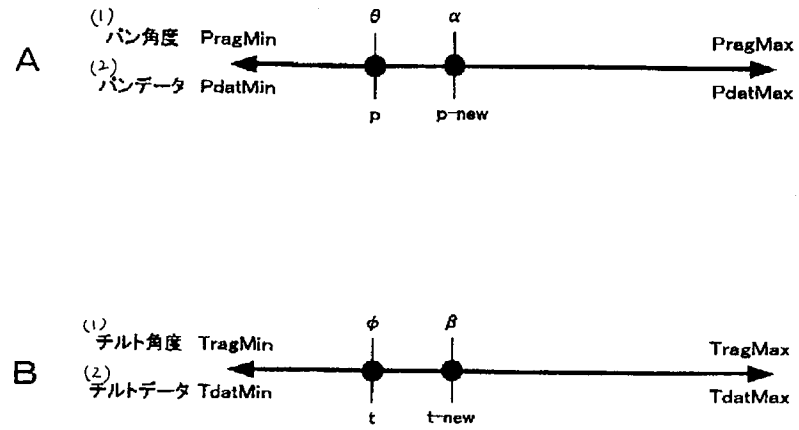
【 図 8 】



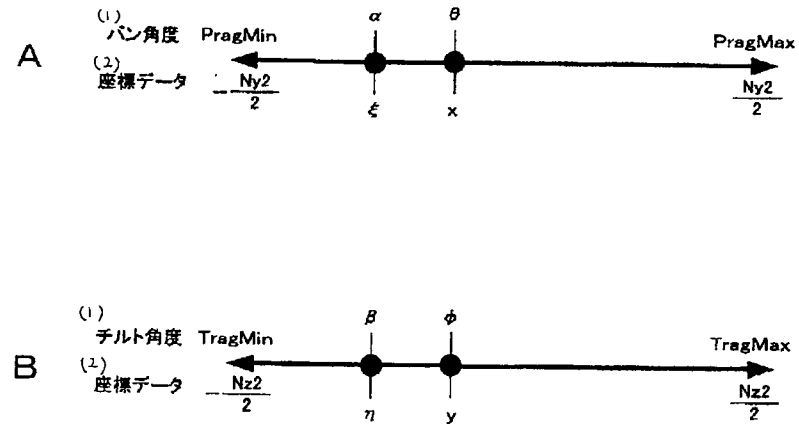
【図 10】



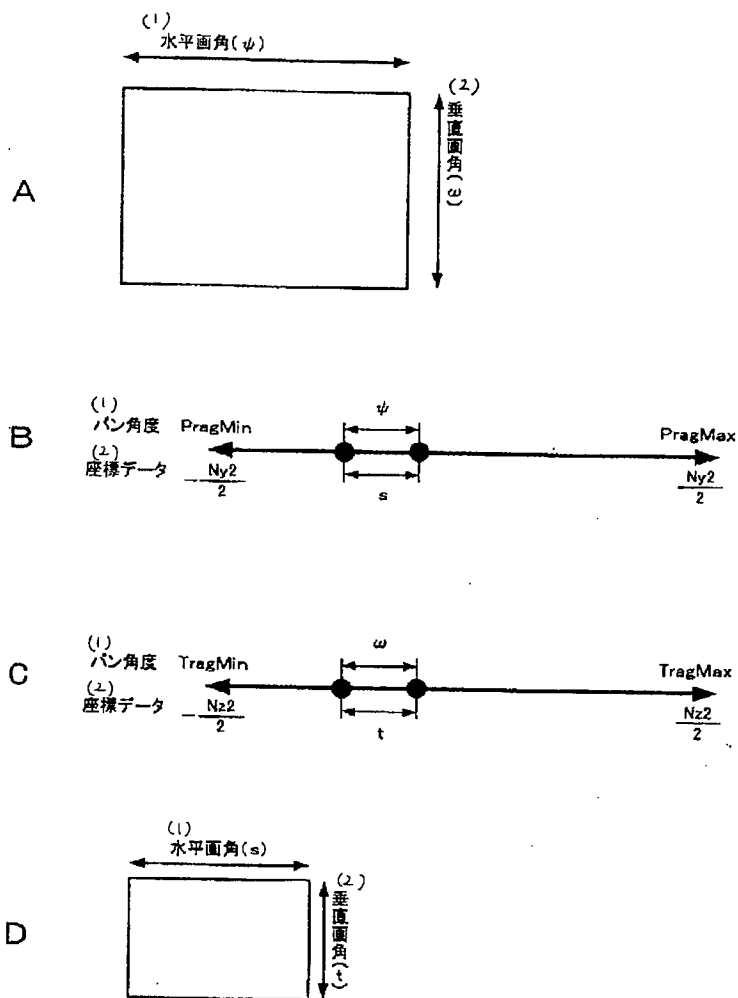
【図 1 1】



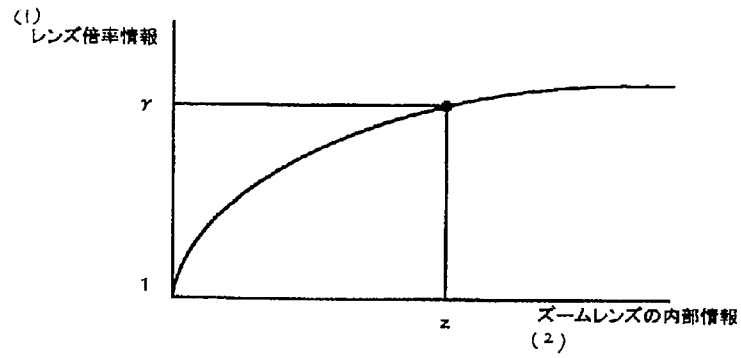
【図 1 2】



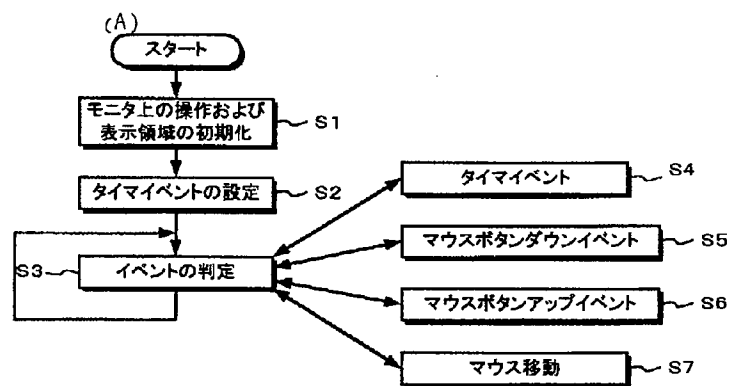
【 図 1 3 】



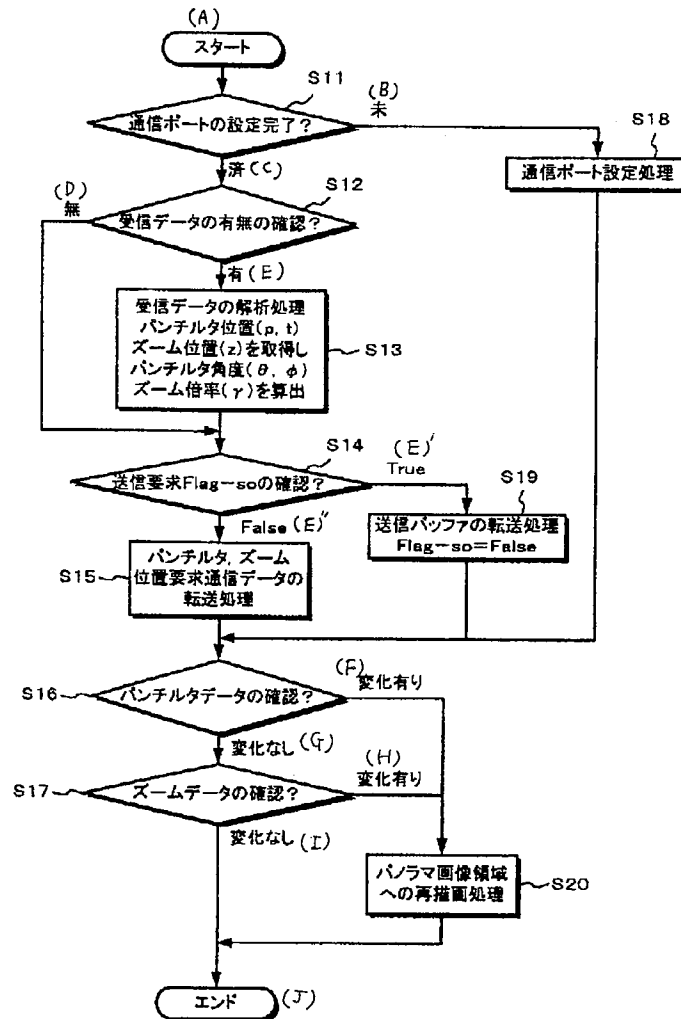
【図14】



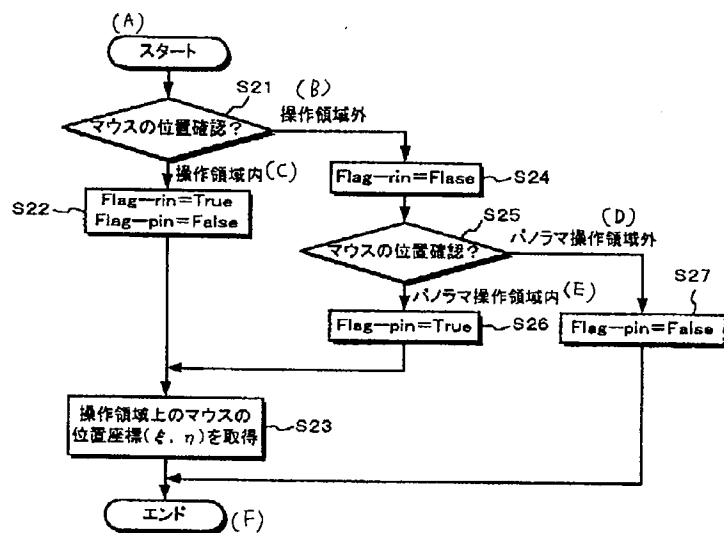
【図15】



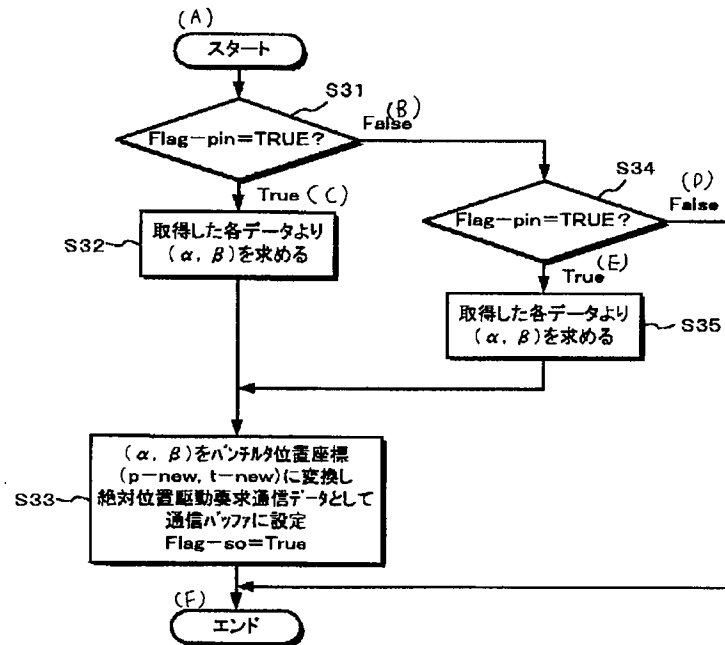
【 図 1 6 】



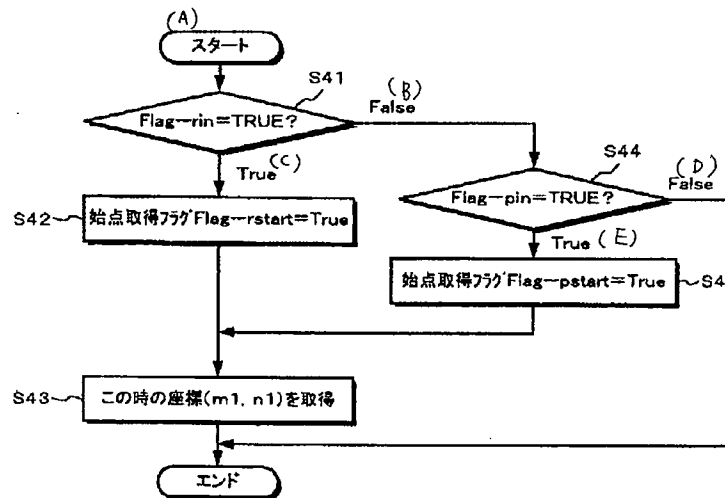
【 図 1 7 】



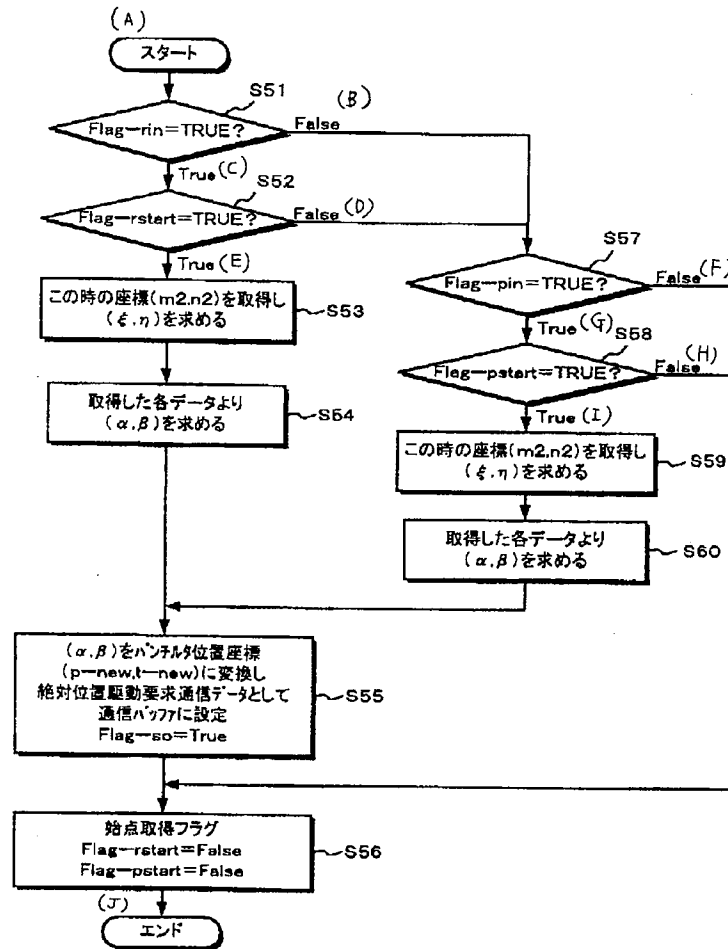
【図 18】



【図 19】



【 図 20 】



【図 21】

